CHILD DEVELOPMENT

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THE SOCIAL MATURITY OF THE VISUALLY HANDICAPPED PRESCHOOL CHILD[1]

KATHRYN ERROLL MAXFIELD
and
HARRIETT ANDERSON FJELD

No satisfactory diagnostic instrument has been available for use in measuring the development of very young visually handicapped children. The Hayes-Binet Test has proved valuable for testing the intelligence of blind children who are 6 years old or more, but it does not go below the 3-year level and is not as well standardized below year 6 as above that age level. With partially seeing children the tests and scales for the seeing sometimes can, sometimes cannot, be used effectively. Often they should be supplemented in order to check the child's performance in terms of his degree of vision and in terms of his ability to get along as an independent human being of a given length of life experience. Unfortunately no such supplementary instrument has heretofore been available for use with blind and low-visioned children under school age.

It can scarcely be hoped, because of the complexity of the problem, that any single diagnostic instrument will be adequate to meet this need. There is a growing realization that even in work with seeing children, such instruments should be used as guides and not as absolute measures. However, when the Vineland Social Maturity Scale appeared, it gave promise as an indicator of growth in social competence for small visually handicapped children even though it was intended originally for use with the seeing.

The use of this Scale was inaugurated, for the purpose of studying its value, as a part of the regular routine at the Arthur Sunshine Home and Nursery School for the Blind in 1935. In 1938, financial difficulties necessitated the closing of the Arthur Home, thus also bringing to a temporary close our work on the study of the Vineland Social Maturity Scale.

On both the first and the second projects there has been splendid cooperation from agencies for the blind having preschool children under their care. Grateful appreciation is expressed to the following organizations: The New York Association for the Blind, the New York State Bureau of Services for the Blind, the Connecticut School for the Blind, the Boston Nursery for Blind Babies, and the Pennsylvania Institution for the Instruction of the Blind. Several parents also cooperated.

Before the close of the first period, at the suggestion of Dr. Doll, Mrs. Bradway spent sufficient time at the Arthur Home to give valuable suggestions on procedures and interpretations. She had already made a study at the Pennsylvania Institution for the Instruction of the Blind which gave her considerable insight into the problems involved (3).

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[1] *The extension and completion of this study was made possible through a grant-in-aid to Dr. Maxfield by the Social Science Research Council.*

The authors are grateful to Dr. Edgar A. Doll for his generous offers of assistance throughout the project and for his critical review of the manuscript.

Since the full report is too long for publication, two copies of it, in manuscript form, have been placed on file in the Lending Library of the American Foundation for the Blind, 15 West 16th Street, New York City.

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THE PROBLEM

The purposes of the project have been: first, to evaluate the Vineland Social Maturity Scale as a useful measure of the general social competence of visually handicapped preschool children; second, to work toward a tentative revision of the Scale which would make it more adequate for comparing visually handicapped children with each other; and third, to discover specific items on which visually handicapped children are retarded and which might serve as bases for future studies.

To accomplish these purposes the data have been treated in three different ways. First, a quantitative investigation was made, the results of which were merely indicative, owing to the wide variability among relatively few subjects; second, seventeen case histories were studied, each in relation to a series of ratings on the Social Maturity Scale, and third, an evaluation of the individual items was made on the basis of all available material.

METHOD AND PROCEDURE

Materials. As has already been indicated, the Vineland Social Maturity Scale was the chief instrument used in this study (7). According to Dr. Doll it covers an unlimited age range but standardizes normatively from birth to 30 years, with the average adult ceiling at 25 years. Sixty-five items fall below the 7-year level.[2] The Scale was standardized on seeing people.

Doll, who supervised its construction, states: "The items of the Scale avoid the measurement of intelligence, personality, habits, skill, and the like, as such, focusing instead on the composite capitalization of such abilities for socially significant behavior" (5). In other words, it aims to be a measure of what might be called effective social behavior. Bradway, in her study of 300 feebleminded subjects, found a correlation of .85 between social age and mental age, and she states that, on the average, children of high intelligence would be expected to obtain higher *absolute* scores but lower *relative* scores than would children of low intelligence (2).

The whole Scale consists of 117 items, only the first 77 of which were used for this study. The 77th item was chosen as the end of the series because it was the last item in that year level which contained the last plus score for any of the children in our group. The items are numbered in order of increasing average difficulty as found for the normal seeing children used in Doll's study (5). They are grouped by age levels with from 3 to 17 items at each level. Furthermore, the items have been classified under the following categories:

Self-Help, General (SHG)	Locomotion (L)	Self-Direction (SD)
Eating (SHE)	Occupation (O)	Socialization (S)
Dressing (SHD)	Communication (C)	

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[2] *For purposes of this study 7 years has been considered the upper limit of the preschool age, because of the fact that visually handicapped children are likely to be retarded in entering first grade.*

The items arranged according to age-levels, for the section of the Scale we have used, are as follows:

0 - I

C 1. "Crows"; laughs
SHG 2. Balances head
SHG 3. Grasps objects within reach
S 4. Reaches for familiar persons
SHG 5. Rolls over
SHG 6. Reaches for nearby objects
O 7. Occupies self unattended
SHG 8. Sits unsupported
SHG 9. Pulls self upright
C 10. "Talks"; imitates sounds
SHE 11. Drinks from cup or glass assisted
L 12. Moves about on floor
SHG 13. Grasps with thumb and finger
S 14. Demands personal attention
SHG 15. Stands alone
SHE 16. Does not drool
C 17. Follows simple instructions

I - II

L 18. Walks about room unattended
O 19. Marks with pencil or crayon
SHE 20. Masticates food
SHD 21. Pulls off socks
O 22. Transfers objects
SHG 23. Overcomes simple obstacles
O 24. Fetches or carries familiar objects
SHE 25. Drinks from cup or glass unassisted
SHG 26. Gives up baby carriage
S 27. Plays with other children
SHE 28. Eats with spoon
L 29. Goes about house or yard
SHE 30. Discriminates edible substances
C 31. Uses names of familiar objects
L 32. Walks upstairs unassisted
SHE 33. Unwraps candy
C 34. Talks in short sentences

II - III

SHG 35. Asks to go to toilet
O 36. Initiates own play activities
SHD 37. Removes coat or dress
SHE 38. Eats with fork
SHE 39. Gets drink unassisted
SHD 40. Dries own hands
SHG 41. Avoids simple hazards

SHD 42. Puts on coat or dress unassisted
O 43. Cuts with scissors
C 44. Relates experiences

III - IV

L 45. Walks downstairs one step per tread
S 46. Plays cooperatively at kindergarten level
SHD 47. Buttons coat or dress
O 48. Helps at little household tasks
S 49. "Performs" for others
SHD 50. Washes hands unaided

IV - V

SHG 51. Cares for self at toilet
SHD 52. Washes face unassisted
L 53. Goes about neighborhood unattended
SHD 54. Dresses self except tying
O 55. Uses pencil or crayon for drawing
S 56. Plays competitive exercise games

V - VI

O 57. Uses skates, sled, wagon
C 58. Prints simple words
S 59. Plays simple table games
SD 60. Is trusted with money
L 61. Goes to school unattended

VI - VII

SHE 62. Uses table knife for spreading
C 63. Uses pencil for writing
SHD 64. Bathes self assisted
SHD 65. Goes to bed unassisted

VII - VIII

SHG 66. Tells time to quarter hour
SHE 67. Uses table knife for cutting
S 68. Disavows literal Santa Claus
S 69. Participates in pre-adolescent play
SHD 70. Combs or brushes hair

VIII - IX

O 71. Uses tools or utensils
O 72. Does routine household tasks
C 73. Reads on own initiative
SHD 74. Bathes self unaided

IX - X

SHE 75. Cares for self at table
SD 76. Makes minor purchases
L 77. Goes about home town freely

Each total score can be translated into a Social Age, or Age Equivallent, and by dividing this Social Age by the life age and multiplying by 100, it is possible to obtain a Social Quotient (SQ), or an index somewhat comparable to the IQ. The mean SQ for normal seeing children was found to be approximately 100.

Additional material obtained from the other records of the children at the Arthur Home was utilized in this study. This material includes records of physical condition, of behavior, of progress in the nursery school, and of various factors which might affect emotional stability.

Subjects. A total of 101 visually handicapped children ranging in age from 9 months to 6 years and 10 months was used. They varied in mental ability from an extremely low level to very superior. They ranged in vision from total blindness to a degree of sight which made it possible for them to get about independently.

Pertinent characteristics of the children are shown in Table 1. The main group, of 92 subjects, used in the quantitative analysis has been designated as Group I. These 92 children have been roughly classified according to mental ability and degree of vision.[3]

The classification of the children according to intelligence was of necessity rather arbitrary. The lack of a satisfactory instrument for measuring the intelligence of visually handicapped preschool children has already been discussed. Under the circumstances the best that could be done was to divide these subjects into three general groups, superior, normal, and retarded. Those children who could reasonably be so placed were included in the normal group. Most of the subjects had been known and observed by experienced workers over a sufficiently long period of time to justify their classification on this general basis. For a few of the older subjects fairly satisfactory Hayes-Binet scores were available.

The children were also classified according to degree of visual handicap. It is extremely difficult, often impossible, to be sure of the degree of visual defect in very young subjects except in cases such as enucleation or anophthalmos. For purposes of this study, those having no vision or only light perception were classified as blind, whereas those who had what appeared to be a usable degree of sight were classified as having partial vision.

Procedure. The data include material gathered under the auspices of the Arthur Home, together with additional records obtained after the beginning of work on the present project, through the excellent cooperation given by a few private families and by the organizations mentioned earlier in this report. All of the recordings were made by trained workers who had at one time been connected with the Arthur Home, except for those obtained through the New York State Bureau of Services for the Blind. After careful study, Miss Gertrude Van den Broek of the Bureau, graciously consented to take these records on children whom she was visiting throughout the State.

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[3] The full report discusses more fully the characteristics of the children.

TABLE 1

VARIOUS CHARACTERISTICS OF THE 101 SUBJECTS IN THIS STUDY

										Visual Defect Noticed Within					
Groups	Total	Boys	Girls	Colored	Additional Handicaps	Premature	Serious Illnesses	Progressive Visual Loss	Vision Improved	2 weeks	1 year	2 years	3 years	5 years	Unknown
Total Group	101	61	40	12	15	5	42	4	20	60	22	3	3	1	12
I. Prin. Group	92	57	35	12	14	5	38	4	19	53	20	3	3	1	12
a. Superior	16	12	4	1	3	1	6	2	4	6	5	1	0	0	4
b. Normal	55	27	28	6	5	1	21	2	12	34	11	2	3	1	4
c. Retarded	21	18	3	5	6	3	11	0	3	13	4	0	0	0	4
x. Part. Seeing	46	24	22	6	5	1	14	0	15	29	9	2	0	0	6
y. Blind	46	33	13	6	9	4	24	4	4	24	11	1	3	1	6
II. Very Retarded Group	7	4	3	0	0	0	4	0	1	6	1	0	0	0	0
III. Special Cases	2	0	2	0	1	0	0	0	0	1	1	0	0	0	0

Records of the Arthur Home children were taken at approximately 3-month intervals. From one to 12 records were made for each child, the actual number depending upon the length of residence in the Home after the use of the Scale was adopted. Similar series were obtained on a few other children. In addition, single records were available for a considerable number of subjects.

RESULTS AND THEIR EVALUATION

I. Quantitative Results

The quantitative analyses are based on single records obtained on 99 subjects ranging in mentality from very retarded to superior, and on longitudinal data consisting of a series of 3 records each for 31 subjects.

A. Principal Results

1. The visually handicapped versus the seeing preschool child. The first task was to compare the behavior of young visually handicapped children with that of normal seeing children of corresponding ages as shown by their scores on the Vineland Social Maturity Scale. The 92 subjects, (Group I), used for this purpose ranged in age from 9 months

to 6 years, 10 months and in intelligence from retarded to superior (Table 1).

Table 2, which is not presented here, gives the number of subjects at each life-age level according to groups.

Table 3, which is also omitted, gives gross data regarding life age, social age, and social quotient. As might be expected, it was found that these children average considerably lower in SQ than do normal seeing children, that is, 83.64 for the handicapped as compared to approximately 100 for the seeing children. Even more striking is the extreme variability of the handicapped children as is shown by an S.D. of ± 29.28 and a range of 26 - 163. It was found that the average (83.52) for the normal handicapped group (Group I-B) was about the same as for the whole of Group I and although the S.D. and range were considerably reduced (±18.45 and 40 - 119) they were still very large. Likewise the superior and retarded groups (I-a and c) showed wide variability. It is this extreme variability which makes it doubly necessary to judge with care when working with young visually handicapped children.

Since the items are arranged on the Scale in order of difficulty for seeing children, it was possible to make a comparison between the seeing and the visually handicapped group on the basis of rank order of difficulty of the individual items. This showed whether there were specific items which stood out as particularly difficult or as comparatively easy for the handicapped group, and whether these items clustered together into any sort of pattern.

There were 29 items on which the visually handicapped group differed from the Scale by as much as, or more than, five points in rank order of difficulty. Fifteen of these were relatively easier and 14 relatively more difficult for the handicapped group. It should be pointed out, however, that while the items are presumably arranged on the Scale in order of difficulty for normal seeing children, there is no claim that the steps are of equally increasing difficulty. Thus, a difference of 5 points in order of difficulty may mean a big difference at one point on the Scale and a much smaller difference at another point. Nevertheless, a shift in rank order of as much as 5 points seems to suggest possible significance since the number of items at any single year level is not great.

A close scrutiny of the 29 items mentioned above is of interest. The 14 items which were relatively more difficult for the visually handicapped children than for the seeing children by a difference of more than 5 points are given below. These items are listed under the categories in which they belong in the Scale, in order to disclose any possibility of groupings of this type. The number in parenthesis following the category name indicates the total number of items in the category within the range of the 77 items included in this analysis. The number in parenthesis following each item indicates the number of points' difference in rank order of difficulty compared with the Scale as standardized on normal seeing children.

Self-Help
  General (14 items)
    66. Tells time to quarter hour (9.5)

  - Eating (12 items)
    - 28. Eats with spoon (5)
    - 33. Unwraps candy (6)
    - 38. Eats with fork (9)
  - Dressing (12 items)
    - 47. Buttons coat or dress (5)
- Locomotion (8 items)
- Occupation (11 items)
  - 19. Marks with pencil (15)
  - 22. Transfers objects (8)
  - 24. Fetches or carries familiar objects (8)
  - 43. Cuts with scissors (10)
- Communication (9 items)
  - 10. "Talks"; imitates sounds (5)
  - 58. Prints simple words (10)
  - 63. Uses pencil for writing (8)
- Self-Direction (2 items)
- Socialization (9 items)
  - 4. Reaches for familiar persons (10)
  - 59. Plays simple table games (10)

The fifteen items *relatively* easier for the visually handicapped group as shown by a difference of 5 points or more in rank order of difficulty are as follows:

- Self-Help
  - General (14 items)
    - 8. Sits unsupported (6)
    - 26. Gives up baby carriage (7)
    - 41. Avoids simple hazards (5)
  - Eating (12 items)
    - 16. Does not drool (6)
    - 30. Discriminates edible substances (6)
  - Dressing (12 items)
    - 50. Washes hands unaided (9.5)
    - 64. Bathes self assisted (8)
    - 70. Combs or brushes hair (8.5)
    - 74. Bathes self unaided (8)
  - Locomotion (8 items)
  - Occupation (11 items)
    - 36. Initiates own play activities (5)
    - 57. Uses skates, sled, wagon (6.5)
    - 72. Does routine household tasks (7)
  - Communication (9 items)
    - 31. Uses names of familiar objects (5.5)
    - 34. Talks in short sentences (6)
  - Self-Direction (2 items)
  - Socialization (9 items)
    - 27. Plays with other children (6)

Examination of the two lists of items shows that there are no Locomotion or Self-Direction items in either list. This does not seem particularly significant in the case of the Self-Direction Category, since there are only two such items among the entire 77 items used. However, the lack of any Locomotion items which differ in order of difficulty by as much as 5 points may mean that for these handicapped children the development of locomotion retains about the same relationship to general development as in the case of seeing children.

The largest number of items differing by 5 points or more in rank order of difficulty fall under Occupation, Communication, Eating and Dressing. Three of the Occupation items fall in the relatively easier group, while 4 fall in the relatively more difficult. Two of the latter that is, 19 and 43, would obviously be very difficult for visually handicapped children, if only because the first might often seem to parents a meaningless activity for children with little or no vision, and because the second would impress many as being too dangerous a performance. Two of the Communication items are in the easier list, and 3 in the more difficult. Here again, items 58 and 63 would obviously be difficult for the visually handicapped. In comparing the eating items, it will be noticed that those on the relatively more difficult list require more activity and manipulation than those on the easier list. On the whole, the dressing items seem to be relatively easier for the handicapped group. This is particularly true of the later dressing items.

This study of the relatively easier items revealed a tendency for the visually handicapped, other things being equal, to succeed more frequently on items requiring less initiative, less activity and less aggressiveness. This tendency is somewhat masked by the presence of a few items which require no great initiative but which are especially difficult for the totally blind since the described behaviour has little meaning for them. While the use of hammer and nails was allowed in some instances for 43, the fashioning of objects in clay for 55, the printing of words in braille for 58, and the more advanced use of braille for 63, the substitutions have not been standardized and on the whole are probably more difficult than are the original items for seeing children.

It should be pointed out that item 27 does not require any great initiative or cooperation on the part of the child but merely that he play in the presence of other children without making trouble. As for item 36 some initiative would seem to be required, but experience with blind children of this age indicates that a study of their play behavior would show it to be characterized by relatively less activity than that of seeing children. This would probably be less true of the partially seeing.

Item 57 is definitely an activity item. However, the items it displaces require considerable manipulative skill, the understanding of spatial relationships, the definite use of vision, or an even greater degree of activity.

On surveying the items which were relatively more difficult for the handicapped group there are a few items such as 19, 58 and 63, which may be passed over quickly as being obviously very difficult for the visually handicapped. Items 28, 33, 38, 43 and 47 all require rather delicate manipulation and while they can be carried out without the use of vision, visual perception would greatly simplify the comprehension of the relationship involved in addition to serving as a guide to successful performance. The behavior of the visually handicapped group as measured by these items as well as by items 22 and 24 may indicate the extreme difficulty with which the blind child is able to grasp the significance of spatial relationships, particularly when those relationships are further complicated by use of external objects. For example, it is easier for the small visually handicapped child to find his way about the house and yard than to manipulate a spoon successfully. Experience has shown that it is extremely difficult for a blind child to learn to scoop up food with a spoon. He can carry the food to his mouth when once the spoon is loaded long before he can learn to do the scooping himself. This is probably because it is very difficult to comprehend, without the use of vision, what goes on at the end of the spoon and the relationship of his hand movements to this end-of-the-spoon activity.

The presence of item 10 in the list of the relatively more difficult would seem to indicate that the visually handicapped child is particularly retarded at this early stage in his linguistic development. Early retardation in the use of language has often been observed by those working with small blind children. However, later linguistic items such as 31, 34, and 44 were relatively easier for this group of handicapped children than for the normal seeing children. This, of course, is not to imply that the blind or partially seeing child is actually as well advanced with regard to these items as is the normal seeing child, but merely that he is less retarded on them than on some others.

As item 4 is worded it represents a type of behavior which is probably meaningless for the totally blind child. He may, and often does, show a desire to be taken up, by whimpering and wriggling, but he will seldom if ever indicate this desire by reaching out. Such signs of recognition as whimpering and wriggling should be given credit, according to the Manual. However it is much more difficult for the seeing adult to interpret such behavior on the part of the blind baby than to interpret the reaching out of a seeing child. It may seem strange, at first thought, that it should be easier for these children to reach for nearby objects than for familiar persons. However, the blind child can learn to find objects by feeling along the surface of the bed or floor, or the sides of his crib, and this is very probably a more meaningful performance than is reaching into air for a person to pick him up, especially since he cannot see the response of the person.

An effort was made to discover the effect of differences in mental abilities by comparing the data for the retarded with those for the superior children. These results are presented in the longer article. They were difficult to interpret due to the fact that 50 per cent of the superior group were partially seeing while only 29 per cent of the retarded group were partially seeing. However, they seem to be in line with those obtained by Doll who found that in comparing the results for normal and feebleminded subjects the Scale was quite consistent as to the progression of items with regard to difficulty (6).

2. The blind versus the partially seeing preschool child. Although there were 46 blind and 46 partially seeing children in Group I, the blind were, on the average, considerably younger than the partially seeing. Consequently, a matched group of 28 blind and 28 partially

seeing subjects were chosen from among those in Group I for closer study. The children were matched for age and as nearly as possible for intelligence. By using the matched pairs it was possible to get a measure of actual difficulty as well as of relative difficulty on the various items for the two groups.

The blind and the partially seeing were closely matched in age since the average age in each case was 4.07 and there were the same number of children at each age level. Table 4, not included here, shows the number of subjects at each age level for the matched groups. The two groups could not be matched as closely for mental level since, as pointed out above, no quantitative measure could be used. However, in each case a child in one group classified as retarded was matched with one of approximately the same age who was classified as retarded in the other group. The same was done with those classified as normal and superior.

Various characteristics of the matched groups are shown in Table 5. The subjects were matched for sex wherever possible, but this could not be carried through completely. It is probable that the discrepancies here were not highly important, since Bradway states that "no item of the revised scale shows a significant sex difference" (1). The blind group is slightly loaded with children having additional handicaps.

Gross data with regard to life age, social age, and social quotient are given in Table 6, which is omitted here. The mean social quotient

TABLE 5

VARIOUS CHARACTERISTICS OF 28 BLIND AND
28 PARTIALLY SEEING MATCHED SUBJECTS

										Visual Defect Noticed Within					
Groups	Total	Boys	Girls	Colored	Additional Handicaps	Prematurity	Serious Illnesses	Progressive Visual Loss	Improved Vision	2 weeks	1 year	2 years	3 years	5 years	Unknown
Total Group 1-0 to 6-11															
Part.Seeing	28	15	13	2	2	0	9	0	10	17	7	1	0	0	3
Blind	28	21	7	3	5	2	12	0	2	12	8	0	3	1	4
Younger Group 1-0 to 3-11															
Part.Seeing	13	7	6	0	2	0	6	0	5	8	4	0	0	0	1
Blind	13	7	6	0	3	2	7	0	2	6	4	0	1	0	2
Older Group 4-0 to 6-11															
Part.Seeing	15	8	7	2	0	0	3	0	5	9	3	1	0	0	2
Blind	15	14	1	3	2	0	5	0	0	6	4	0	2	1	2

for the partially seeing is higher than that for the blind. The difference is not statistically reliable, since the groups are small and the variabilities great. Nevertheless, it probably represents a real difference, since it is fairly large, and, in accord with observation, it favors the partially seeing.

A comparative analysis was made of the scores for the blind and the partially seeing on each item in the series from 1 to 77. The comparison was made, first, by a count of the number passing each item and, second, by arranging the items in rank order of difficulty for the blind and for the partially seeing separately. By the first method it was possible to compare the actual difficulty of each item for the two groups. For example, item 31 (Uses names of familiar objects) was passed by 21 of the blind and by 25 of the partially seeing children, showing that this item was more difficult for the blind.

The comparisons of the items at the ends of the series do not actually differentiate the two groups, since the early items are too easy and those at the other extreme too hard. The last two items, as well as items 66 and 73 were failed by all of the subjects.

Although 15 items showed identical scores for the blind and the partially seeing, 4 of these were zero scores and 7 were perfect ones, leaving only 4 which give any measure of comparative difficulty. Twenty-one items showed higher scores (were easier) for the blind children, 19 of them differing from the corresponding scores for the seeing by 0.5 to 2.5 points, and two differing by from 3.0 to 4.5 points. Forty-one showed higher scores for the partially seeing, 27 of them differing from the corresponding scores for the blind by from 0.5 to 2.5 points, 13 differing by from 3.0 to 4.5 points, and 1 by 5 points. Obviously, many of these differences are slight and with a larger number of subjects might be considerably changed.

A detailed study presented in the complete manuscript indicates that the blind children tended to excel in items which require less initiative and less out-going behavior.

The comparison was made on the basis of actual difficulty of the individual items. It is also of interest to determine whether there is a difference between the blind and the partially seeing as to the order of difficulty of the various items. For this reason, a second comparison was made of the paired groups by arranging the items in the order of difficulty as they occured first for the blind and then for the partially seeing, noting those items which showed large differences in relative difficulty. There were 21 items beyond the 0-1 year level which showed a difference of 5 points or more in rank order of difficulty for the two groups of children. Thirteen of these were relatively easier for the partially seeing and 8 for the blind.

All the items that were relatively easier for the blind were found to be included in the previous list of items which were actually easier for them. The same thing holds true for all in the lists for the partially seeing with the exception of two items, Numbers 21 and 29. These two were actually easier for the partially seeing but did not appear in the former list because they differed by less than the three points necessary for inclusion. In other words, the items listed here are both actually and relatively easier for the children.

The results suggest that the blind children in this study tend to be more docile, have less initiative, are less active and outgoing, are more introverted, and possibly more cooperative than the partially seeing children. It is to be noted also that, on the whole, the differences found to exist between the blind and the partially seeing children follow the pattern of behavior which appeared in the comparative study of the total visually handicapped group and the normal seeing children as shown by the Scale.

As an additional check on this, the larger groups of 46 partially seeing and 46 blind children were compared as to rank order of difficulty for each item, in order to see whether or not the results would be consistent with those found for the matched groups. In each case the difference was in the same direction as for the matched groups. Furthermore, there were only 5 additional items upon which the larger groups differed by more than 5 points in order of difficulty. Three of these, 12, 13, and 14 were below the one-year level and thus were not included in the lists although the scores actually differed by more than 5 points. The other two, items 52 and 63, showed differences of only 4 points and so were not included in the lists.

A comparison of the data in Tables 3 and 6 (which are not presented here) showed that the larger groups differed considerably more in mean social quotient than did the matched groups. The means for the larger groups were 91.17 for the partially seeing and 75.91 for the blind, making a difference of 15.26. For the matched groups, the means for the partially seeing were 87.71 and for the blind 80.21, making a difference of 7.50. However, a larger difference is to be expected with a larger and unmatched group.

It appears, then, that the results found for the larger groups were fairly consistent with those found for the matched groups. Both sets of data indicate that, on the average, the blind preschool child does differ from the partially seeing in certain respects.

The question next arises, if the blind and partially seeing differ from each other on certain items, do they differ from the normal seeing child on the same items and in the same way? The order of difficulty of the 77 items for the 46 blind children was compared with that of the Scale and, likewise, the order of difficulty for the 46 partially seeing children was similarly compared, in order to see whether the differences for the two handicapped groups occurred on the same items and in the same direction.

These comparisons revealed that there were 34 items out of the 77 on which the blind children differed from the Scale as standardized for normal seeing children by 5 points or more in order of difficulty. The partially seeing children differed from the Scale in the same direction on 29 of these items. There were 28 items on which the partially seeing differed from the Scale by 5 points or more in order of difficulty. The blind differed in the same direction on 26 of these. The two groups differed from the Scale by 5 points or more in opposite directions on only one item (Number 49).

It appears, then, that with few exceptions those items which were relatively more difficult for the blind were also relatively more difficult for the partially seeing. In other words, the differences in behavior so far as they are measured by this test are largely differences in degree.

3. Tentative age norms for visually handicapped preschool children. The evidence suggests that separate standardization might well be made for the blind and partially seeing, but the present data are quite insufficient for this. However in view of the fact that for the most part the blind and the partially seeing tend to differ from the normal on the same items and in the same direction, and in view of the fact that both groups show extreme variability, it seemed worth while to use the total group of 92 subjects for the purpose of working out tentative norms for the visually handicapped, regardless of degree of sight, on each of the items upon which there was a usable amount of data. This meant that it was necessary to have a fair number of cases at each age level down to the age where one could be reasonably sure that the next lower age level would bring approximately 100 per cent of passes and up to that age where one could be reasonably sure that the next age level would bring approximately 100 per cent of failures.

The Thompson method of calibration was used here, as in the original standardization of the Scale (6). Age norms were found for 32 items, as shown in Table 7. In each case it seemed reasonably certain that approximately 100 per cent of the visually handicapped children below the age of one year would fail and that approximately 100 per cent above 7 years would pass the item. It will be noticed that no item below 15 and none above 52 was used. Furthermore, some of the intervening items were omitted because the available data concerning them did not meet the criteria. It should be emphasized that these age norms are extremely tentative because of the relatively small number of children at certain age levels and because of the unequal distribution of the blind and partially seeing at the different age levels. The 2-3 year level was particularly inadequate with only 9 subjects, of whom all were blind except one. Any age norms for visually handicapped children should be used with great caution because of the amount of diversity among the children and the limited numbers available at a given age level for standardizing purposes. They have been presented here in the hope that they may furnish the incentive for further study and the development of more accurate norms.

B. Longitudinal Results

Among the children whose records were used in the preceding section, there were 31 upon whom 3 or more recordings had been made at approximately 3-month intervals. In order to obtain a further check on the value of the Scale as a developmental measure, these 31 subjects were used for a longitudinal study. Since there were only 3 recordings for some of these children and an uneven number for the others, only 3 recordings were used for each of them. Because of the small number of subjects this longitudinal study did not prove to be sufficiently enlightening to warrant publication of the results in this article.

However, on the whole, it can be said that while individual items did reflect progress on the successive recordings, they varied considerably from item to item as to the amount and consistency of progress shown. An adequate longitudinal study of this type would require a much

TABLE 7

TENTATIVE AGE NORMS FOR THIRTY-TWO ITEMS AS FOUND FOR VISUALLY HANDICAPPED PRESCHOOL CHILDREN

Scale Age Level	Item Number	Age Norm Handicapped	Scale Age Level	Item Number	Age Norm Handicapped
0 - 1	15	1.8	2 - 3	35	3.1
				36	2.7
1 - 2	18	2.0		37	3.2
	21	2.0		38	4.5
	22	2.6		39	4.1
	24	2.8		40	3.6
	25	2.4		41	3.0
	26	1.9		42	4.3
	27	2.0		44	3.8
	28	2.9			
	29	2.2	3 - 4	45	3.9
	30	2.2		46	4.3
	31	2.3		47	4.7
	32	2.5		48	4.3
	33	3.5		49	4.6
	34	2.5		50	3.8
			4 - 5	51	4.7
				52	4.5

larger number of subjects studied over a longer period of time with preferably separate treatment of the data for the blind and the partially seeing.

II. Case Histories for Seventeen Children

The full report gives the detailed case histories of 17 children for whom ample data were available. This material not only furnished considerable information with regard to each child's behavior but also concerning factors relating to his health and to various situations causing emotional disturbances. Such records, made by teachers, nurses, and trained observers over a period of time, served as a valuable criterion of the validity of the scores on the Vineland Social Maturity Scale taken over the same period.

The 17 case histories which were presented in the full report showed in general very close agreement between the behavior notes and the trends indicated by the Social Maturity scores. This is especially noteworthy since the cases covered a wide range in general behavior level and variations in developmental trends from rapid progress to actual retrogression.

A number of factors appear to have affected the level of the SQ. Among the most important seemed to be health, specialized training, and general environment. Improved vision appeared to be an important factor in two cases and of possible significance in two others. Deep seated emotional disturbances appeared to play definite roles in lowering the SQ at specific periods in the development of three cases.

However, the general tendency for the SQ to rise during the child's stay at the Home would seem to indicate that training is an important factor in the Social Maturity of the visually handicapped child as measured by the Vineland Social Maturity Scale. This increase in SQ occurred in all except the very low grade cases and that of one child whose SQ dropped 17 points over a period of approximately 6 months due to a serious eye condition. In some cases this improvement was attributed, in part, to improved health or improved vision or both, but in others there was little change in health or vision. Dr. Doll suggests the possibility that the improvement in SQ of the various children may have been due to delayed development owing to lack of vision. There is little doubt that this may have been a factor in certain instances. However, it seems likely in the cases studied that much of this delay in development could have been avoided by special training at an earlier period in the life of the child.

Some of the children showed definite limitations and thus a tendency for the SQ curve to level off even under continued intensive training. No doubt this would have been true in all cases if the training had continued long enough. In the very low-grade cases there was a tendency toward retrogression after a long period of intensive training. This retrogression on the part of the very retarded subjects may indicate that the intensive training was too great a strain and finally proved to have a disintegrating effect.

It would be impossible to say to what extent a given SQ is dependent upon natural ability and to what extent it is dependent upon training. It seems a fair assumption that the visually handicapped child is much more dependent upon training than is the seeing child. The ordinary environment and the usual methods of training are far more adequate and stimulating to the seeing than to the blind baby. Consequently the blind baby is likely to sink into a kind of vegetative state if no special effort is made to arouse his interest in his environment. This is somewhat true, but to a much less degree, of the partially seeing infant.

III. Further Evaluation of Individual Items

In the full report there is an exhaustive analysis of each item in terms of its probable fairness to blind and low visioned children under school age. Much of this analysis is based on the experience which the investigators have acquired as a result of working not only with the children in this study but with others in their own homes over a period of years. Constant reference was made to data accumulated by the present investigation.

The necessity for this evaluation lay in the need for working out a tentative adaption of the Vineland Social Maturity Scale for use with these children. There were two somewhat different objectives in attempting to revise the Scale. It was hoped that a scale might be evolved which would be adequate both for the comparison of the visually handicapped with the seeing in regard to social competence and for comparison of the visually handicapped among themselves. It is conceivable that a scale might be admirably adapted to the one and yet quite inadequate to the other use. Only the summaries presented for each year-group of items to years VII - VIII are given here.

O-I

With few exceptions the items below the one-year level appear to be useful for measuring the development of visually handicapped children. The chief difficulty found in the practical application of this part of the Scale is that the steps are too large. Visually handicapped babies make less rapid progress at this stage and there are definite in-between stages of progress particularly in motor development which appear to be more significant for the visually handicapped than for the normal seeing infant. Specific suggestions along this line will be made in the section on suggested revisions of the Scale.

I-II

All the items at the one-to-two year level have been found to be useful for work with the visually handicapped except 19, 26, 27, and 30. Some of the other items need redefining or splitting up into two separate items, and some in-between steps should be added.

II-III

Two of the items at this age level, 41 and 43, are of doubtful value for use with visually handicapped children. Forty-one might be useful if redefined and another item added. Both items 36 and 38 need redefining and at least one Dressing item should be added.

III-IV

Five of the 6 items at this age level have been found useful. Two, 45 and 47, were found to have definite limitations and one item, 46, needed rewording and redefining.

IV-V

It has been found that one item, 53, needs redefining and that two items, 55 and 56, penalize the visually handicapped children too severely without offering an adequate measure of their progress. Other items should be added which would measure the development of these children in Occupation and Socialization.

V-VI

With the possible exception of Item 57, the items at the 5-to 6-year level have been practically useless for measuring the development of this group of visually handicapped children.

VI-VII

Two (62 and 64) of the items at this age level appear to be useful and the other two, 63 and 65, inadequate for use with the visually handicapped.

No adaption is attempted beyond the year-group V-VI.

The following paragraphs discuss more specific revision which might improve the usefulness of the Scale for work with visually handicapped children. It is likely that some of the difficulties encountered in the use of the Scale with the visually handicapped have also been experienced in its use with the seeing. No doubt the revision of the Scale upon which Doctor Doll is now working will resolve many of these difficulties.

The Scale as presented here is in extremely tentative form and is set up with the hope that it may be used in the near future with a sufficient number of visually handicapped children so that it can be put into more permanent form. It cannot be too strongly emphasized that none of the revisions of original items and none of the new items have been even tentatively standardized on visually handicapped children. That would require another extended project. In other words, the revision is merely ready to be tried out.

The need for certain types of revision for use with visually handicapped preschool children has been revealed by the quantitative data and by the experience of those working with the Scale in connection with visually handicapped children. It should be pointed out that the increase in number of items representing smaller steps in development, and tapping a somewhat greater variety of behavior areas, may in the end yield only negligibly different total scores and yet may prove invaluable for diagnostic purposes. The suggested revisions have come in part from the study of seeing children by Gesell et al. (9). Others have come from an infant schedule mentioned in an earlier article (8) which was used for three or four years in the Arthur Home and revised a number of times according to need. Still others were based upon the more general observation and experience of those working with the Scale.

No attempt has been made to revise the order of the original items on the basis of order of difficulty found for the 92 visually handicapped children constituting the principal group in this study. There has been no attempt at revision beyond the 5 to 6-year level, since little material was available beyond that point.

The general organization as to categories and age levels of the original Scale has been adhered to. The items have been numbered consecutively throughout, with a letter following to indicate the category to which each item belongs. The various categories are designated as follows:

Self Help: General - G
Eating - E
Dressing - D
Locomotion - L
Occupation - O
Communication - C
Self-Direction - S-D
Socialization - S

The letters and numbers in parenthesis preceding the items should be interpreted as follows: (N) indicates that the item is new, in that it does not appear in the original Scale; a number followed by the letter R, as (6R) indicates that the item does occur in the original Scale but has been revised in some way either as to definition or wording, or has been otherwise changed; a number alone, as (15) indicates that the item has been used without modification. The description and definition of the items have been included in all cases of new and redefined items.

THE VINELAND SOCIAL MATURITY SCALE AS TENTATIVELY REVISED FOR USE WITH VISUALLY HANDICAPPED PRESCHOOL CHILDREN

0 - I

(N) 1/G. Turns head from side to side.
Turns head from side to side when in prone position.

(1) 2/C. "Crows"; laughs.

(2) 3/G. Balances head.

(N) 4/G. Grasps objects upon contact.
Will grasp and hold small objects when they come in contact with his hand.

(3) 5/G. Grasps objects within reach.

(4R) 6/S. Responds to human beings.
Responds to presence of nurse or parents by wriggling, gurgling or otherwise showing desire for being picked up and pleasure at being held or cuddled.

(5) 7/G. Rolls over.

(N) 8/G. Attempts to regain lost objects.
Makes definite effort to reach out for desired objects which have slipped from grasp but which are still in contact.

(6R) 9/G. Reaches for nearby objects.
Attempts to obtain objects which are slightly beyond reach, of which he is aware through some sensory stimulation-visual, auditory, olfactory or tactual-kinaesthetic (vibration).

(N) 10/O. Accepts objects when offered.
Will take and hold object for short time when it is placed in hand.

(7R) 11/O. Occupies self unattended.
*a. Plays with objects three or more minutes.
Bangs, shakes, feels or otherwise plays with object more than momentarily.

b. Amuses self with one or more objects for periods as long as 15 minutes.

(N) 12/O. Shows some choice of objects.
Shows preference in toys. Plays more consistently with some than with others. May show pleasure when given some toys and indifference toward or rejection of others.

(8R) 13/G. Sits unsupported with back straight.
a. Ten seconds or more. Sits voluntarily with back straight on firm flat surface without support, for 10 seconds or more.
b. Several minutes.
Same as a. except for extended time.

(9R) 14/G. Pulls self to standing position.
a. Makes definite attempt. Pulls self to standing position when adult is assisting by holding under arms, to both hands, or to clothing, etc.
b. Holding to crib or other object. Comes to standing position by holding to some object (not a person).

*In each case where an item has been divided into two parts it is assumed that each could carry the weight of one-half point. However, this would necessarily be determined by data obtained when the revised scale was tried out.

(N) 15/G. Lowers self from standing to sitting position.
Comes to sitting from standing position without falling and without assistance from another person. May help self by holding to objects.

(10) 16/C. "Talks"; imitates sounds.

(11R) 17/E. Drinks from cup or glass assisted.
  a. Adult holding glass.
  Accepts liquid from glass rather than bottle. Glass may be held entirely by adult but infant is able to drink from it without much spilling.
  b. Helps to hold glass.
  The child holds glass but cannot be depended upon to retain his grasp.

(12R) 18/L. Moves about on floor.
Moves about in one fashion or another, creeping, pulling himself about in sitting position or even sliding around in an almost prone position or hitching along in a backward direction.

(13) 19/G. Grasps with thumb and finger.

(N) 20/G. Releases objects.
  a. Releases with contact.
  Is able to transfer small object from one hand to the other or to release it against a resisting surface as a table top or floor.
  b. Drops objects voluntarily.
  Can voluntarily release object in mid-air without touching any surface.

(14) 21/S. Demands personal attention.

(N) 22/L. Walks sideways when holding to pen or furniture.
Takes steps sideways without assistance of person but holding on to crib, pen, wall, furniture, etc.

(N) 23/L. Walks assisted.
  a. Walks forward when held by both hands.
  Takes steps forward when assisted by person holding both hands or given support on both sides. Child holds much of his own weight but does not balance.
  b. Walks with slight assistance.
  Has almost attained balance and independent control but is unable to go alone either through lack of confidence or actual physical inability. May be helped by adult holding one hand, by harness fastened about the waist having reins which may be held lightly by adult. Sometimes merely holding the child slightly by the clothing at the back of the neck will give him confidence. Any method might be used which gave only slight physical support but which would serve to give confidence to the child.

(15) 24/G. Stands alone.

(16) 25/E. Does not drool.

(17R) 26/C. Follows simple instructions.
  a. Inhibits on command.
  Will inhibit certain simple acts upon simple familiar command.
  b. Makes positive response to command.
  Can perform simple pantomime like pat-a-cake, hand a toy, shake a rattle, or come to a person on command.

I - II

(18R) 27/L. Walks alone.
a. Few steps.
Takes a few steps (four or more) unassisted and unsupported by person or object.
b. Across room.
Walks without assistance or support approximately the distance of the width of an ordinary room.

(N) 28/O. Examines objects with interest.
Begins to show curiosity about objects in his environment as demonstrated by fairly intent examination either by feeling, tasting or "trying out" in various ways.

(N) 29/O. Responds to sounds.
Makes definite response to various sounds such as bells, whistle, etc.

(N) 30/O. Manipulates objects.
Works movable parts of objects, as hinged box top, a toy with movable parts, removable lid on a box or can.

(N) 31/D. Cooperates in dressing.
Finds large arm-holes and in general cooperates in dressing.

(20) 32/E. Masticates food.

(N) 33/D. Removes mittens and cap.
Is able to remove mittens and cap when unfastened and not too tight. Does so as an act of undressing and not just in play.

(21R) 34/D. Pulls off socks or shoes.
Removes socks or shoes when unfastened if not too tight. Does so as an act of undressing and not merely in play.

(22R) 35/O. Transfers objects.
a. Places objects.
Picks up and puts down objects definitely rather than merely dropping them.
b. Arranges objects.
Arranges objects with relation to each other. May be somewhat disorganized piles or groups. Carries objects around. May use push or pull toys.

(N) 36/O. Responds to music.
Makes general body response to rhythm. May hum or sing.

(23R) 37/G. Solves problems.
a. Overcomes very simple obstacles.
Can push small chairs or other small objects out of the way, back walker or kiddie-kar, when he runs into large object, or solve other simple problems.
b. Uses intermediary objects.
Climbs on stools, chairs or boxes to reach; uses stick as implement, etc.

(23R) 38/G. Uses receptacle for carrying.
Uses basket or other receptacle for carrying small objects from one place to another, or for transporting sand or water.

(24R) 39/O. Fetches or carries familiar objects.
a. Across room.
Will carry familiar object across room from one person to another if object is in hand.

b. From one room to another.
Will carry familiar object from one person in one room to person in another familiar room.

(25R) 40/E. Drinks from cup or glass.
a. Holds glass with supervision.
Can hold glass while drinking but may drop it instead of replacing it on table.
b. Holds cup unassisted.
Handles cup or glass well and can replace on table.

(27R) 41/S. Plays with other children.
Parallel play but obviously enjoys being with other children. Only slight give and take. Some attempt to defend own rights. May be considerable snatch and grab.

(28R) 42/E. Eats with spoon.
a. Assisted.
Shows definite attempt to feed self but food may be put on spoon and help given in guiding spoon to mouth.
b. Unassisted.
Uses spoon without help and with moderate spilling.

(29R) 43/L. Goes about house or yard.
a. Holding to walls or other objects.
Independent of other people; may cling to objects for security and finding way about, but goes about house or yard alone. May have to be watched from a distance to assure his keeping out of mischief or danger.
b. Walks about freely.
Walks about freely in house and yard with only occasional use of objects as guides.

(N) 44/C. Says two or more words.
Must be words which have definite meaning for the child.

(N) 45/C. Indicates needs or desires through language and gesture.
Indicates some needs or desires such as food, toilet or drink through the use of language and gesture.

(31) 46/C. Uses names of familiar objects.

(32R) 47/L. Walks upstairs.
a. Assisted.
May require considerable encouragement and be physically helped by holding one hand, or dress or by slight boost on the buttocks, but child holds rail and definitely attempts to step and pull himself up in upright position.
b. Unassisted.
May be accompanied and encouraged but not physically helped. May hold to rail.

(32R) 48/L. Walks upstairs unaccompanied.
Walks upstairs "on his own." Must walk, not creep. May hold to rail.

(34) 49/C. Talks in short sentences.

II - III

(N) 50/D. Helps with panties.
Makes definite effort to pull up or push down panties, if not fastened, as an act of undressing or when going to the toilet.

(35) 51/G. Asks to go to toilet.

(36R) 52/O. Initiates own play activities.
Handles objects, exploring and examining them. Carries objects such as blocks around in containers, transports them in wagons and dumps them out. More prolonged and organized play than items 35 or 38. Plays very simply with dolls and teddy bear.

(N) 53/O. Interested in tactual qualities.
Touches and feels objects of various textures, exploratively, like fur, velvet, satin, etc.

(N) 54/O. Carries out constructive activity (substitute for 43). Manipulates materials such as clay, bread dough, mud-pounding, rolling, poking and pulling pieces off. Uses peg board putting large pegs in without help. Uses hammer and large headed nails, hammering nails into soft surfaces.

(N) 55/S. Attends to stories.
Will listen attentively to short simple stories which have repetition and which have familiar characters.

(N) 56/C. Uses pronouns - - I, me, you.
Uses these pronouns with some understanding.

(37R) 57/D. Removes coat or simple garment.
Removes simple garment as coat or dress which opens clear down when unfastened, if not tight or in any way difficult to pull off.

(38R) 58/E. Eats with fork.
May use it much as he uses a spoon but is able to carry food to mouth with only moderate spilling.

(40R) 59/D. Dries own hands.
a. Goes through the motions.
Results not yet acceptable.
b. Acceptably.

(N) 60/C. Uses past tense and plural forms.
Makes correct use of both.

(41R) 61/G. Avoids simple hazards.
(Same as original with following addition) But does not show excessive timidity.

(42R) 62/D. Puts on coat or simple garment.
a. Assisted.
Can put it on if handed it in right position and helped slightly in getting started. Need not fasten.
b. Unassisted.
Same as original 42.

(44) 63/C. Relates experiences.

III - IV

(N) 64/L. Jumps with both feet.
Jumps from low box or off of bottom step with both feet.

(45R) 65/L. Walks downstairs one step per tread.
Walks down without help, placing a given foot on alternate steps. In other words,

does not step down with one foot and then bring the other foot down placing it on the same step.

(46R) 66/S. Cooperative play at pre-school level.
Plays in small groups of two or three. Is beginning to cooperate in various ways, as rocking boat, doing things together, willing to wait turn. Plays circle games. Participates with group in rhythms.

(N) 67/D. Unbuttons front and side buttons.
Undoes all front and side buttons if not excessively small.

(47R) 68/D. Buttons front and side buttons.
Buttons all front and side buttons if relatively large unless buttonholes are too small or buttons are particularly difficult because of shape or for some reason are hard to get at.

(48) 69/O. Helps at little household tasks.

(N) 70/O. Makes "pies", "cakes."
Makes forms with some approximation to that of objects represented, as pies, cakes, etc. May use mud, clay, sand, or other medium.

(50) 71/D. Washes hands unaided.

IV – V

(51) 72/G. Cares for self at toilet.

(52) 73/D. Washes face unassisted.

(53R) 74/L. Goes about neighborhood unattended.
Goes about immediate neighborhood unsupervised. "Immediate neighborhood" does not necessarily involve the crossing of streets. Knowledge of whereabouts and activities may be required and child may be restricted as to area.

(54) 75/D. Dresses self except tying.

(56R) 76/O. Uses pencil or crayon for drawing.
In addition to original definition the following activities should be given credit: The use of clay, mud or other medium to make recognizable forms, or the use of buttons, blocks, pegs or other materials to make well-defined designs.

(N) 77/S. Takes part in dramatic play.
Plays singing games, takes part in dramatized songs or stories.

(N) 78/S. Laughs at "funny" situations.
Responds to nonsense rhymes and funny stories. May create stories with silly language.

(N) 79/G. Skips.
Skips or hops on one foot with some proficiency. Not just one or two hops but across the room. May change from one foot to the other.

V - VI

(57) 80/O. Uses skates, sled, wagon.

(N) 81/S. Well adjusted to leaving familiar persons.

Leaves the home for school or other destination alone or with playmates without difficulty in parting from adult to whom he is emotionally attached.

(N) 82/O. Carries out extended projects.

Is interested in projects which carry over from day to day such as building structures to be used for special purposes as dramatic play. May make objects to be used for special purposes. These enterprises may be carried out alone or in groups. The child may need slight suggestions or supervision from adult but shows definite interest in completing what he starts.

(N) 83/S. Responds to competition.

Competes with other children of approximately same age and in same group.

(N) 84/S. Adjusts to formal situation.

Adjusts readily to group situations and to modern kindergarten regulations which require a certain amount of restraint, routine and conformity to rules. Can go with adult on short shopping tours, to make short calls, etc., without causing any great concern as to behavior.

(N) 85/C. Tells long story accurately.

Is able to tell a fairly long but simple story of two or three episodes which has been read or told to him at home or at school, getting the principal facts correct. If an imaginative child, may add to and change some of the details to suit his own fancy.

(N) 86/C. Asks questions of how and what and meanings of words.

Is interested in how things work, what they are for, and in the meanings of words.

(N) 87/L. Can cross streets.

Is trusted to cross streets alone where there is relatively little traffic. Watches for cars and obeys traffic lights when necessary.

SUMMARY AND CONCLUSION

The chief purpose of this study was to further the development of an adequate scale for measuring the general social competence of visually handicapped preschool children. An attempt was made to ferret out specific types of behavior in which these children tend to be retarded.

The first 77 items of the Vineland Social Maturity Scale, including years from zero through ten, were used as the basis for the study. An intensive study was made of the scores of 101 visually handicapped children ranging in age from 9 months to 6 years and 10 months. The effect of differing degrees of blindness and of intelligence upon the total scores as well as upon the scores of individual items was investigated. Tentative age norms for visually handicapped children were obtained for 32 items, as many as was possible with the existing data.

The validity of the scale was checked against the case histories of 17 visually handicapped preschool children for each of whom a series of Social Maturity recordings had been obtained and for whom there were behavior notes and records of physical conditions and emotional factors.

An evaluation of individual items was made on the basis of all available material, and finally a tentative series of 87 items was suggested as the basis for a new study. Twenty of these were taken from the Vineland Social Maturity Scale without revision, 31 with revision; 36 were new items taken from various sources and from the experience of the investigators with visually handicapped children.

In conclusion, (1) The Vineland Social Maturity Scale was found to have considerable value for work with visually handicapped preschool children: (2) A few items were found to be of little value, and others needed revision for work with these children; (3) There appeared to be a need for additional items representing smaller steps of progress, and also for items tapping other types of behavior; (4) The results definitely indicated that these children, as a group, were retarded on specific items, and (5) These visually handicapped children, on the average, appeared to be more docile, less active, and have less initiative than seeing children of corresponding ages. This behavior pattern was more striking in the blind than in the partially seeing.

The present article is published in the hope that clinicians will be willing to try the two scales with whatever visually handicapped children may come to their attention and that they will then notify the authors of the results. Cooperation in the evaluation of this adaptation will be greatly appreciated. Mimeographed copies of the tentative adaptation may be obtained upon request from Kathryn E. Maxfield, 40 East 61st Street, New York City.

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THE DEVELOPMENTAL STATUS OF SPEECH SOUNDS OF TEN FEEBLE-MINDED CHILDREN

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This report represents the first step in a systematic study of the use of vowel and consonant elements by feeble-minded children. The purpose is to determine developmental trends in the speech of mentally retarded children and to relate data acquired in this field to the processes of development in normal infants and children and to the status of adult speech. Ultimately, information concerning the comparative rates of speech development in normal and feeble-minded children may be established and remedial measures for speech retardation may be set up. A further aim is to try out several indices of speech status on this type of data.

Transcriptions of the speech of a group of twenty-five low-grade feeble-minded children in a state institution were attempted. Unfortunately a sufficient sample of sounds could be secured for only thirteen of these children. A considerable amount of time is necessary to make a transcription on each child and many of them produce sounds only after long intervals. Frequently no vocalization occurs. The work was done during the first week of the year 1941. A second transcription of the sounds of these children was obtained on December 22, 1941. Approximately, then, a year had elapsed between the taking of the two samples. During the year the number had been further reduced by death to ten cases. It is recognized that ten cases do not constitute an adequate sample for sound statistical treatment; nevertheless, there are tendencies in these data which possess at least preliminary meaning, and an elaborate statistical treatment will be postponed pending the accumulation of more cases.

The method of sampling the speech sounds of immature children has been described elsewhere (4). Briefly, it consists of such sounds as occur on a given number of breaths of each subject. In the present study 30 breaths constituted the sample from each child. The vowel sample on the first transcription consisted of 417 elements. On the second transcription it amounted to 560. The total thus is close to 1,000 vowel sounds. On the first transcription 174 consonant elements were included; on the second, 332. The total consonant sounds used by these children thus amounted to about 500. Altogether, about 1,500 separate speech elements are available for analysis.

Transcriptions were taken in the International Phonetic Alphabet as adapted by Fairbanks (1). The problem of the reliability of the observer and of the data in transcriptions of the speech of immature children has been discussed by Irwin and Curry (4), Irwin and Krehbiel (5), and Irwin and Chen (3).

At the beginning of the year these children ranged in age from about one to five years with a mean age of three years. All of the children are low-grade feeble-minded cases, idiots and imbeciles. Their IQ's ranged from 7 to 48. The average is 29. Among them are Mongols, hydrocephalics, and unidentified clinical types. Thus clinically they do not constitute a homogeneous group. General information concerning these ten children is tabulated below.

Subject	IQ	Clinical Type	Age Second Transcription		
			Years	Months	Days
1	22	?	3	3	10
2	48	Mongol	2	9	10
3	7	?	4	9	12
4	45	?	5	7	20
5	18	Hydrocephalic	4	10	10
6	39	Hydrocephalic	5	0	5
7	*	Mongol	3	6	17
8	32	?	5	10	23
9	23	?	3	10	0
10	25	?	4	1	7

*Passed only one item on Kuhlmann-Binet. The item is turning the head to source of sound.

The original data are presented in four tables. They will be analyzed in terms of the vowel-consonant ratio, the vowel ratio, and as vowel and consonant dispersions plotted graphically in the form of profiles. Under each of these analyses comparisons will be made with the corresponding indices of the speech status of infants and adults. Table 1 gives the frequency of occurrence of each of eleven vowels for each of the ten subjects. The data for each vowel are arranged in two columns representing the first and the second transcriptions. Table 2 is similarly organized but presents the corresponding per cents of frequency in two columns for each subject. Tables 3 and 4 present frequencies and per cents of frequencies of consonant elements in a manner comparable to that of Tables 1 and 2 for vowels.

These tables furnish the basic data from which the tabulations and analyses of the speech sounds of the feeble-minded children are derived. The comparative data on speech sounds of infants are from studies done by the writer and his associates. The data on adult speech sounds status are from Voelker (6).

The first matter of interest is the question: Do any of these children use meaningful language? Of the ten cases only one (Number 4), a boy of five and one-half years, exhibited meaningful speech patterns, and these consisted only of mutilations and approximations. Of the 30 breath samples of his sounds transcribed at the beginning of the year, 10 were meaningful patterns and 20 were meaningless. At the end of the year 15 of the 30 samples were meaningful. Thus he increased his use of meaningful approximations during the course of the year from one-third to one-half. None of the other subjects of this group exhibited the slightest tendency toward meaningful expression. Thus the bulk of this report concerns sounds characteristic of the premeaning stages of speech devel-

TABLE 1

FREQUENCY OF VOWELS

Subject	i		I		e		ε		æ		ʌ		a		ɔ		o		ʊ		u	
	1*	2**	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	1	1	19	20			8	2	12	23	7		1					1	9	1	1	
2		1	5	4			17	26		1	22	12		7				3		12	9	
3	3	8	17	18	2	1	26	22	1		6	14							4	1		
4	4	11	9	21	2	4	2	7	1	2	6	15	1	7		2	11	7	11	16	4	2
5	1		16	27			4	11			2	17		5					7	5		1
6	1		9	28	4		18	8	1		1	1							6		3	
7	2	1	14	17			4	14	5		2	14										
8	1	3	11	14	2		29	15				4		3					4	2	5	
9	2		4	7			10	10			8	14				1		2	4	6		
10		3	4	31			6	22			6	8		1								
Total	15	28	108	180	10	5	124	137	20	26	60	99	2	23	0	3	11	13	45	43	22	3

*Indicates first transcript

**Indicates second transcript made one year later

TABLE 2

PER CENT OF FREQUENCY OF VOWELS

Subject	i		I		e		ε		æ		ʌ		a		ɔ		o		ʊ		u	
	1*	2**	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1	2	2	32	41			14	5	21	48	12		2					2	18	2	2	
2		2	10	5			40	34		2	50	16	9					4		16		12
3	5	12	20	28	3	2	44	34	2		10	22							7	2		
4	8	11	18	21	4	4	4	7	2	2	12	16	2	7		4	21	7	21	17	8	4
5	3		52	41			14	17			7	26		7					24	7		2
6	2		21	75	10		42	22	2		2	3							14		7	
7	7	2	52	38			15	30	19		7	30										
8	2	7	21	34	4		55	37				10		7					8	5	10	
9	8		14	18			35	25			29	35				2		5	14	15		
10		5	24	41			38	38			38	14		2								

* Indicates first transcript

**Indicates second transcript made one year later

opment and in this respect resembles the speech of infants under twelve months of age.

The data assembled in the tables furnish answers to the question: How many of the vowel and consonant elements appearing in adult English speech do these feeble-minded children use? The following tabulation gives the number of subjects using each vowel sound.

Vowels	i	I	e	ε	æ	ʌ	a	ɔ	o	ʊ	u
Number of Subjects Using Vowel Sound	8	10	4	10	5	10	6	2	4	8	6

It may be seen that all ten use the sounds I, ε, and ʌ. The range is from 2 to 10. It is apparent from the tabulation that fewer of these feeble-minded children use back vowels than front vowels.

There are in adult English speech approximately thirteen vowel sounds (broad transcription). These feeble-minded children have not mastered the use of all of them. The matter is explicated in the next tabulation.

TABLE 3

FREQUENCY OF CONSONANTS

Subject	p		b		m		w		ʍ		f		v		θ		ð		t		d		n	
	1*	2**	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1			3		13	2													3		13	17	3	24
2				1				1												1	14			3
3				1		3	3	6															2	
4	3	5	1	3		4		2				1		3			1		5	10	2	8		4
5			2	13														3		2		14		
6						1																		
7						8																	4	
8						5	5														1	4		5
9						6																1		
10																							2	4
Total	3	5	6	18	13	29	8	9				1		3			1	3	8	13	30	44	12	40

Subject	s		z		ʃ		ʒ		l		v		j		k		g		ŋ		h		ʔ	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1																		1				1		2
2									3									5			2	3		1
3													2	2		5		2			6	3		
4	2	5			2	1			1	4		2			11	7	3	4			4	9		
5		8		3										10							22	1		
6																	2				12	14		1
7				1																	11	3		6
8				1															1		5	20		
9																					2	7	3	1
10														2								22		12
Total	2	13		5	2	1			4	4		2	2	14	11	12	5	12	1		64	80	3	23

* Indicates first transcript

**Indicates second transcript made one year later

TABLE 4

PER CENT OF FREQUENCY OF CONSONANTS

Subject	p		b		m		w		ʍ		f		v		θ		ð		t		d		n	
	1*	2**	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1				9	37	4													9		36	37	9	51
2				2				19													33	39		0
3				4		12	27	25																8
4	9	6	5	4		6		3			1			4			1		15	14	6	11		6
5			9	24														6		4		28		
6						8																		
7						38																		18
8						14	45														10	11		14
9						40																6		
10																							100	10

Subject	s		z		ʃ		ʒ		l		v		j		k		g		ŋ		h		ʔ	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1																		2			2			4
2										8								14			66	8		2
3													18	8		23		8			55	12		
4	6	8			6	1			3	6		3			39	10	9	8			13	12		
5		14		6										18							81	2		
6																	14				86	80		6
7				5																	100	14		23
8				3																3	45	55		
9																					40	40	60	5
10														5								55		30

* Indicates first transcript

**Indicates second transcript made one year later

Subject Number	1	2	3	4	5	6	7	8	9	10	Average
Number of Vowels	9	9	8	11	7	8	5	8	7	5	7.7

Subject 4 uses 11 of the full number of vowels. He is the child whose speech exhibits a degree of meaningful patterning. The fewest number of vowel sounds used by any of these cases is 5. The average for the group is 7.7 vowels.

In adult speech about 24 consonant sounds occur. In the following tabulation may be seen how many feeble-minded subjects use each of them.

Consonants	p	b	m	w	ʍ	f	v	θ	ð	t	d	n
Number of Subjects Using Consonant Sound	1	5	7	4	0	1	1	0	2	3	6	7

Consonants	s	z	ʃ	ʒ	l	r	j	k	g	ŋ	h	ʔ
Number of Subjects Using Consonant Sound	2	3	1	0	2	1	3	2	5	1	10	6

The range is from 0 to 10. Three of the consonants are not used by any of the children. These are ʍ, θ, and ʒ. The sound h is used by all.

The number of consonants articulated by each of the ten subjects appears below.

Subject Number	1	2	3	4	5	6	7	8	9	10	Average
Number of Consonants	8	9	9	17	8	4	5	7	4	4	7.5

Again Subject 4 leads with 17 consonants in his repertoire. The range is from 4 to 17 consonants. The average for the group is 7.5.

The vowel-consonant ratio may be taken as a convenient index of developmental status of speech. Since there are about 13 vowels to 24 consonants in adult speech, the vowel-consonant ratio for mature speech is 1 to 2. The next tabulation includes vowel-consonant ratios for each of the ten children and for the group as a whole.

Subject Number	1	2	3	4	5	6	7	8	9	10	Group	
$\frac{v}{c} =$	$\frac{9}{8}$	$\frac{9}{9}$	$\frac{8}{9}$	$\frac{11}{17}$	$\frac{7}{8}$	$\frac{8}{4}$	$\frac{5}{5}$	$\frac{8}{7}$	$\frac{7}{4}$	$\frac{5}{4}$	$\frac{7.7}{7.5}$	or 1

Of the ten cases only three have vowel-consonant ratios less than 1, two have ratios of 1, and five are greater than 1. None of the ten shows the mature ratio of 1 to 2. For the group as a whole the vowel-consonant ratio is 1.

The following tabulation gives the vowel-consonant ratio for newborn infants, for the ten feeble-minded cases, and for mature speech.

	Vowels average	Consonants average	Ratio
Newborns	2.7	2.2	3 to 2
Feeble-minded (Mean age - 4 years)	7.7	7.5	1 to 1
Adults	13.0	24.0	1 to 2

Another suggestive index of speech development is the vowel ratio. It is based on the relation of the per cent of frequency of front vowels to the sum of the per cents of frequencies of middle and back vowels. In month-old infants (2) front vowels constitute about 80 per cent of all vowels spoken, whereas middle and back vowels amount to 20 per cent of the total. In adult speech front vowels constitute 50 per cent, and middle and back vowels also 50 per cent (6). It is evident therefore that a fundamental process of development in early speech consists of the mastery of back vowels.

In order to indicate speech retardation, the vowel ratio may be applied to speech data of feeble-minded children. Table 5 presents the vowel ratios of each of the ten children for the first transcript as well as for the second one taken a year later. The values are in terms of per cents.

It will be noted that most of these ratios of front to middle and back vowels deviate greatly from that of normal adult speech. In only two cases is the ratio comparable to that of adult speech. Both transcripts for Subject 2 show the fifty-fifty relationship. The second transcript of Subject 4 also shows this proportion. The tabulation gives the per cents and the ratios for the group as a whole at the beginning and at the end of the year.

	Per Cents		Ratio	
	First	Second	First	Second
Front	66	67	2	2
Middle + Back	34	33	1	1

There can be no doubt that in the ratio of front to middle and back vowels the group as a whole has made no progress whatever, although one case did show improvement.

It would be of value to compare this result on low-grade feeble-minded with the progress during the course of a year which might possibly be made in speech status of high-grade feeble-minded children such as morons and borderline cases. Such data are not available. However, our work on infant speech sounds has advanced far enough to make tentative comparisons which may be helpful in determining approximately the developmental position of this group of feeble-minded children.

The following tabulation gives the vowel ratios for one-month infants (2), for the ten feeble-minded cases, for six-month infants (5), and for adults (6).

Subjects	Per Cent		
	Front	Middle + Back	Ratio
One-month	80	20	4 to 1
Feeble-minded (Mean age = 4 years)	67	33	2 to 1
Six-months	55	45	1 to 1 (Approximately)
Adults	49	51	1 to 1

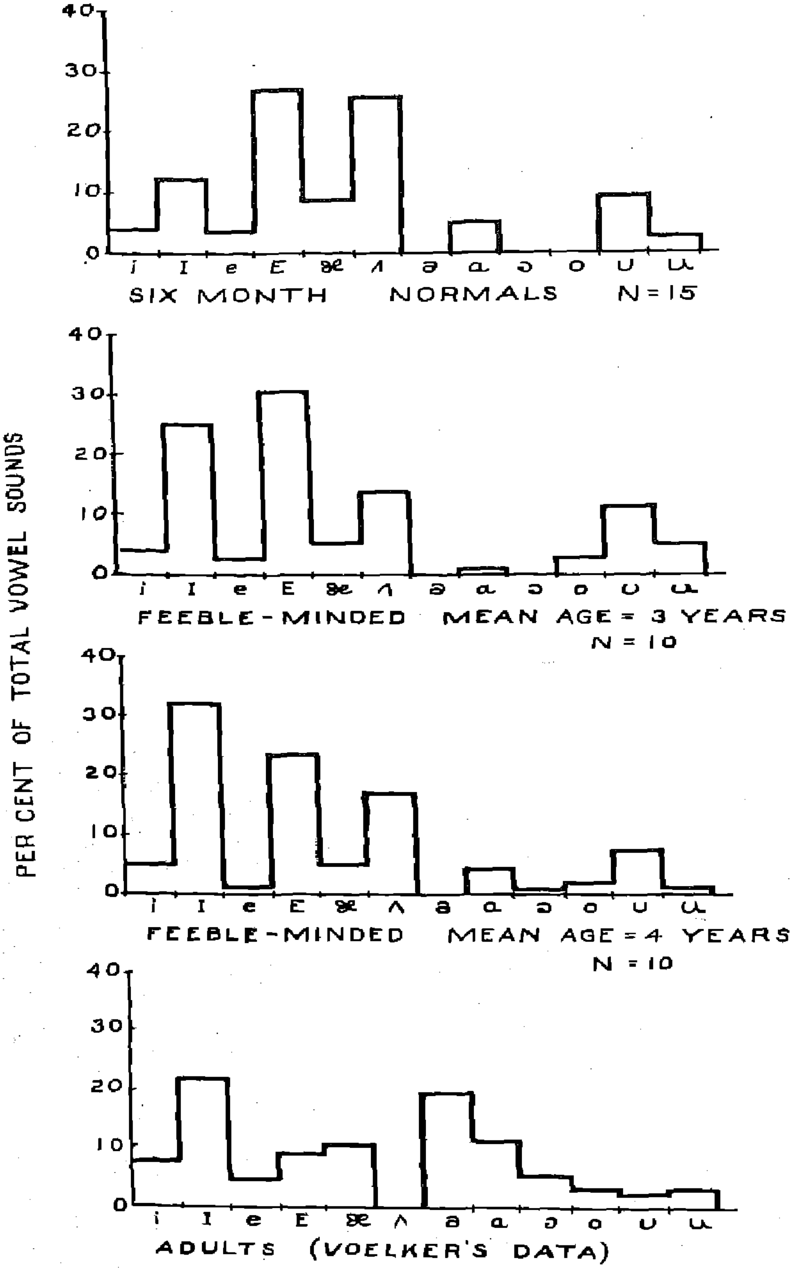
TABLE 5

Vowel Group	Subject	Transcript	
		First	Second
Front	1	69	96
Middle+Back		31	4
Front	2	49	50
Middle+Back		51	50
Front	3	83	77
Middle+Back		17	23
Front	4	15	48
Middle+Back		85	52
Front	5	66	57
Middle+Back		33	43
Front	6	77	97
Middle+Back		23	3
Front	7	92	70
Middle+Back		8	30
Front	8	91	69
Middle+Back		9	31
Front	9	57	42
Middle+Back		43	58
Front	10	62	84
Middle+Back		38	16

Thus a series of ratios such as the above establishes the approximate position in development of these feeble-minded children.

A useful graphic method for the simultaneous presentation of central tendencies in the dispersion of speech sounds is the profile (2). The method may be applied to the vowel and consonant production of the ten feeble-minded children in order to give an account of the distribution of these elements. Vowel and consonant profiles are found in Figures 1 and 2 in juxtaposition with other developmental data.

Figure 1 comprises three profiles comparing the vowel status of feeble-minded children with that of six-month infants and with adults.



SIX MONTH NORMALS N = 15

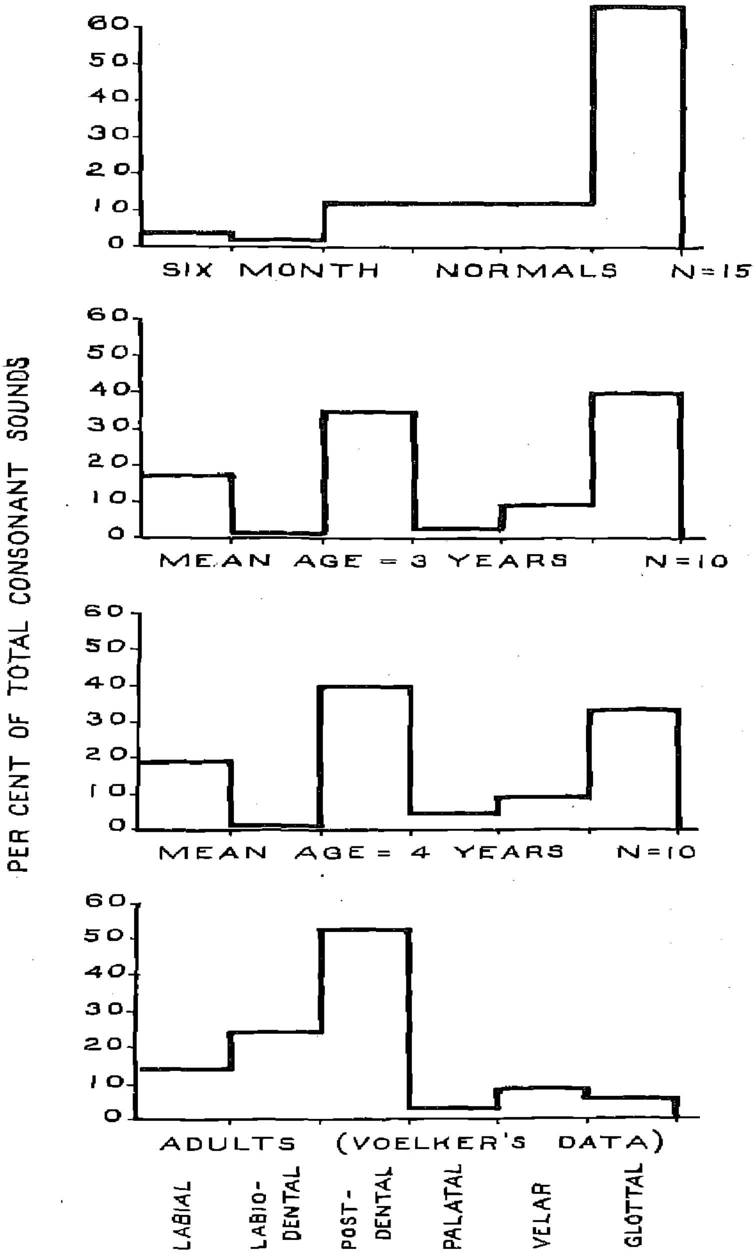
FEEBLE-MINDED MEAN AGE = 3 YEARS
N = 10

FEEBLE-MINDED MEAN AGE = 4 YEARS
N = 10

ADULTS (VOELKER'S DATA)

VOWEL DISPERSION

FIGURE 1



CONSONANT DISPERSION

FIGURE 2

It will be apparent that there is little difference between the patterns of distribution at three years and at four years of the group of feeble-minded cases. Moreover, it is noteworthy that the concentration within each of the first three profiles is toward the left, that is, toward the front vowel sections of the profiles. Thus a profile of the dispersion of vowel sounds in the speech of the feeble-minded resembles that of six-month children much more than it does that of adult speech in which the distribution is about equal on both halves of the profile.

Figure 2 compares the two consonant profiles of the feeble-minded subjects with that of six-month infants and with that of adults. Here, too, there is little difference between the patterns of consonant distribution at the beginning and end of the year. There is a heavy concentration of elements in the glottals in the consonant articulation of infants. In adult speech concentration is largely in the labials and dentals. However, in the speech of the feeble-minded subjects consonant articulation is mainly in the labials, the post-dentals, and the glottals. Whereas among infants the consonant dispersion shows a concentration to the right of the profile, in the adult the concentration is to the left. This suggests that the problem of speech development in regard to consonants during the early stages of life is concerned to a great extent with a mastery of the articulation of labials and dentals. In this connection the status of the feeble-minded is interesting. Their profiles show an increment among the labials and dentals part way along the course of development. Glottal sounds are less frequent than in the case of the infants, but more frequent than in adults. The dominance of the post-dentals, characteristic of adults, has not been achieved. In a word, the infant and adult profiles are each unimodal with the modes at opposite ends, while the profiles for the feeble-minded definitely exhibit a trimodal type of distribution.

Although these data comprise only a segment of a broader research in the immature stages of human speech development, there are some conclusions which may reasonably be inferred from them. These are:

1. Feeble-minded children use back vowels more infrequently than front vowels. In this respect their speech resembles that of young infants rather than that of adults.
2. In consonant articulation the dispersion is trimodal whereas in young infants and adults the distributions are unimodal. The feeble-minded show a concentration in the labial, post-dental, and glottal regions while infants show the greatest piling up among the glottals, and adults among the post-dentals.
3. The ratio of vowels to consonants in the speech sounds of this group of feeble-minded children is 1, whereas that of mature speech is 1 to 2. None of the ten subjects exhibits the mature ratio.
4. The developmental status of the speech sounds of the group of four-year-old feeble-minded children approximates that of normal children less than one year of age.
5. The vowel ratio, the vowel-consonant ratio, and the profile are suitable tools for analyzing the speech sound status of retarded children.

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THE CRITICAL EVALUATION OF THE VIENNESE TESTS AS APPLIED TO 200 NEW YORK INFANTS SIX TO TWELVE MONTHS OLD[1]

DOROTHY S. ACKERMAN

This critical evaluation of the Viennese Baby Tests was undertaken in order to appraise the usefulness of the tests devised by Dr. Charlotte Buehler, for measuring the development of infants.

The main problem of this investigation was the application and validation of the Buehler tests for the second half of the first year of life as presented in "Testing Children's Development" by Charlotte Buehler and Hildegard Hetzer (1). In Buehler's developmental scale there are four series for this period of life, one each for the 7th, 8th, 9-10th and 11-12th months. Each series consists of ten items covering the fields or categories of an infant's behavior.

I. TESTS

The categories which are recognized by the tests include the fields of sense stimulation and spontaneous movements, called 1) Sense reception, and 2) Bodily movements. Another category is 3) Social behavior, or contact with other human beings. Two other fields are called 4) Learning and 5) Manipulation of materials, or the change of behavior on the basis of experience and the activity of the individual by which he controls his environment. Finally 6) Mental productivity, the creation of and striving toward goals.

All thought processes are included in this 6th category except that in this system "language", the thoughtful understanding of a situation which manifests itself in conversation, is classified under social behavior. "Imitation" is classified under "learning". The field of sense reception did not receive detailed study in our investigation because most early sensory development is made during the first half of the first year of life. The sixth field, mental production, appears in three test items for the 11-12th month period.

According to Charlotte Buehler, all instances of the use of the tests that have come to her attention yielded a median Developmental Quotient (DQ) of 1.0. The test series in the first year of life were given in Vienna to 20 children of each age group and the results of the tests established the suitability of the test items. In standardizing the Vienna test items the minimum percentages which were considered sufficient to include an item, were fixed at 66 per cent success instead of the more usual 75, because consideration was given to the fact that the performance of children in practical test situations would be below that of those tested under the experimentally optimal conditions of the standardization procedure. The Vienna percentages obtained ranged from 50 to 82 passing the item at the age-level assigned but more and less difficult items compensated each other so that the averages of all items in each series passed were 67.2 per cent.

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[1] *Condensation of doctoral dissertation, Department of Psychology, Fordham University, New York, N. Y.*

CHILD DEVELOPMENT, Vol. 13, No. 1 (March, 1942)

In America, Ruth M. Hubbard reported a study of the reliability and validity of this Buehler Infant Scale (3). She gave 124 tests in all; thirty-eight babies were retested once and 8 babies were retested twice. Hubbard found that the reliability coefficient of the half-scale for all tests to be .96. For the alternate items for all tests of the developmental ages of the 78 children, one month through 12 months' old, the reliability was found to be .84.

To obtain a measure of the validity of the Buehler scale, Hubbard tested 11 subjects with the Merrill Palmer performance scale when they became old enough. She reported that there seem to be some tendencies for those children who rate high on the Buehler scale to rate high also on the Merrill-Palmer. Hubbard looked for another indication of the validity of the scale in the distribution of the quotients. Her distribution was fairly regular except for the trend toward the high scores.

Optimistically Hubbard concluded "that the scale seems fairly reliable in comparison with other infant scales and has some predictive capacity with respect to rating on pre-school tests. It would seem, therefore, worth while that it be given to a large group of representatively chosen American infants to determine whether or not the Buehler ratings are spuriously high for the general population."

II. SUBJECTS

The subjects of this investigation were 200 infants, 100 girls and 100 boys. Each of the four age groups (7th month, 8th month, 9th and 10th months, and 11-12th months) was composed of 25 boys and 25 girls, and each sub-group was composed of equal numbers of children of the following natio-racial extraction: British, Italian, Jewish, Nordic and Slavic.[2] Sixteen children were orphans or foundlings in two institutions.

There is evidence that a good sampling of the urban population was secured from the close approximation of the distribution of our subjects with the distributions of Florence Goodenough's socio-economic scale as shown in Table 1 by columns A and B respectively, and with the distributions of David Wechsler's educational status scale (4), as shown in Table 2.

In Table 1, Classes I and II, the professional and semi-professional and managerial, are very nearly equal in the two columns. There is no farmer group to speak of in New York City. However, Classes III, IV, V, VI of Column A, which equal 73.81 per cent of the population as a whole, are almost equal to Classes III, V, VI, of Column B, which equal 71 per cent of the present parents. Class VII includes all day laborers and here too the percentages are not very different for the two columns.

Thirty-one per cent of the parents of these children were found to be foreign born, which closely approximates the percentage (35 per cent) of foreign born in the general population of New York City (5).

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[2] *Most of the subjects were secured through the Baby Health Stations of New York City through the courtesy of Dr. Margaret Barnard, the Director of these stations.*

TABLE 1

SOCIO-ECONOMIC STATUS, GOODENOUGH SCALE

Groups	Occupations of Adult Males	A Goodenough Scale Per Cent	B Fathers of Subjects
I	Professional	2.54	2.5
II	Semi-professional and Managerial	4.70	5.0
III	Clerical, Skilled Trades and Retail Business	14.42	20.0
IV	Farmers	18.74	0.0
V	Semi-skilled occupations and Minor Business	27.40	33.0
VI	Slightly Skilled Trades	13.25	17.0
VII	Day Laborers of all classes	18.96	19.0
	No information		3.5
		100.01	100.00

TABLE 2

EDUCATIONAL CATEGORIES OF PARENTS, DAVID WECHSLER SCALE

Educational Category	U.S. Population	Fathers of Subjects
College Graduate	2.93	3.0
Some College Work	4.08	2.25
High School Graduate	6.85	5.5
Some High School Work	18.99	18.25
Elem. School Graduate	18.68	34.75
Some Elementary Work	43.58	30.75
Illiterates	4.69	1.5
Unknown		4.0
	99.80	100.00

III. PROCEDURES

A few of the standard materials and toys which could not be duplicated here were imported from Vienna. This was made possible through Dr. Maria Maudry, one of Charlotte Buehler's collaborators, who was teaching at Fordham University at the time this study was undertaken.

The techniques used in testing were the same as described in the text. The tests were given at the infants' homes. Standard Buehler record forms were used for taking down all measurements. In addition a form was devised for recording of pertinent facts concerning the socio-economic status of the family, the number of children and the education of the parents.

Every subject was first given the test items, for the levels below his chronological age, until he passed all the items of a level, and items in the various categories above his chronological age level until he was no longer able to pass any items.

The developmental age (DA) analogous to Mental Age (MA) is obtained by giving day-credit for every item passed. For the series through the 8th month, each item is counted as 3 because there are 10 items for each month or 30 days. For the two series for the 10th and 11-12th months, each item is counted as 6, since there are 10 items for 2 months or 60 days. For the series for the second year in the first two quarters, each item has a value of 9 because there are 10 items for each of the two 3-month levels. The Chronological Age (CA) is obtained by calculating the months multiplied by 30 plus the additional days of the baby's age, from his birthday to the day of the test. The developmental quotient (DQ), analogous to the Intelligence Quotient (IQ), is found by dividing the DA by the CA.

For example, if a child was 7 months and 12 days old (222 days) on the day of his test and passed 9 tests for the 7th month level, 9 tests for the 8th month and 4 tests for the 9-10th month level, he was given a basic age of 6 months plus the 27 days (9 x 3) for the 7th month; plus the 27 days (9 x 3) for the 8th month; plus the 24 days (4 x 6) for the 9-10th months - a total of 78 days, or 2 months and 18 days. This gives a DA of 8 months and 18 days (258 days). The DA of 258 days divided by CA of 222 days equals DQ of 116.

In order to facilitate examining the various categories of the series an original feature was devised: the calculation of the partial developmental ages and quotients in every field for each child by the same process used in arriving at the general DQ.

IV. VALIDATION

Distributions of the obtained developmental quotients (DQ's) for each of the four age groups and for the total groups are presented in Table 3, together with the mean, median and standard deviation of each distribution.

TABLE 3

DEVELOPMENTAL QUOTIENTS OF SUBJECTS - TABLES OF FREQUENCIES

DQ Interval	All Cases	7th Month	8th Month	9-10 Month	11-12 Month
65-69	0	0	0	0	0
70-74	2	1	0	1	0
75-79	3	1	0	0	2
80-84	3	0	1	2	0
85-89	4	1	2	1	0
90-94	15	4	3	4	4
95-99	13	3	0	4	6
100-104	46	11	12	10	13
105-109	38	9	14	8	7
110-114	29	5	5	10	9
115-119	22	7	6	5	4
120-124	10	2	4	2	2
125-129	8	2	3	2	1
130-134	5	3	0	1	1
135-139	2	1	0	0	1
140-144	0	0	0	0	0
Total Cases	200	50	50	50	50
Mean	106.67	107.66	107.67	105.9	105.44
Median	106.0	107.0	106.5	108.0	104.5
Std.Dev.	11.69	13.08	10.64	11.5	11.21

There were 163 DQ's between 90 and 120, with 12 quotients below 90 and 25 above 120, with the lowest at 73 and the highest at 138. These results are rather comparable to those obtained by Hubbard for 58 children under one year of age tested with the Buehler series.

The average developmental quotient (DQ) for our 200 children is 106.67. Buehler reported the average DQ score of her infants tested in Vienna to be 100. The slightly higher scores of our group may be accounted for by the fact that the New York children were representative of the whole urban population while Buehler's infants were all institutional children in Vienna. Our 16 institutional children averaged 101.44, which is closer to the Vienna average.

The distribution of DQ's for the total group is presented graphically in Chart 1. A normal curve has been superimposed on the histogram and it will be noted that the experimental distribution of DQ's for the total group approximates the normal distribution rather closely. Charts 2-5 present the rather close conformity of the four age groups in each instance to the normal curve of distribution.

The developmental quotients in each of the five categories of behavior were computed for each of the four age groups of 50 children and for the whole group of 200 children as shown in Table 4.

TABLE 4

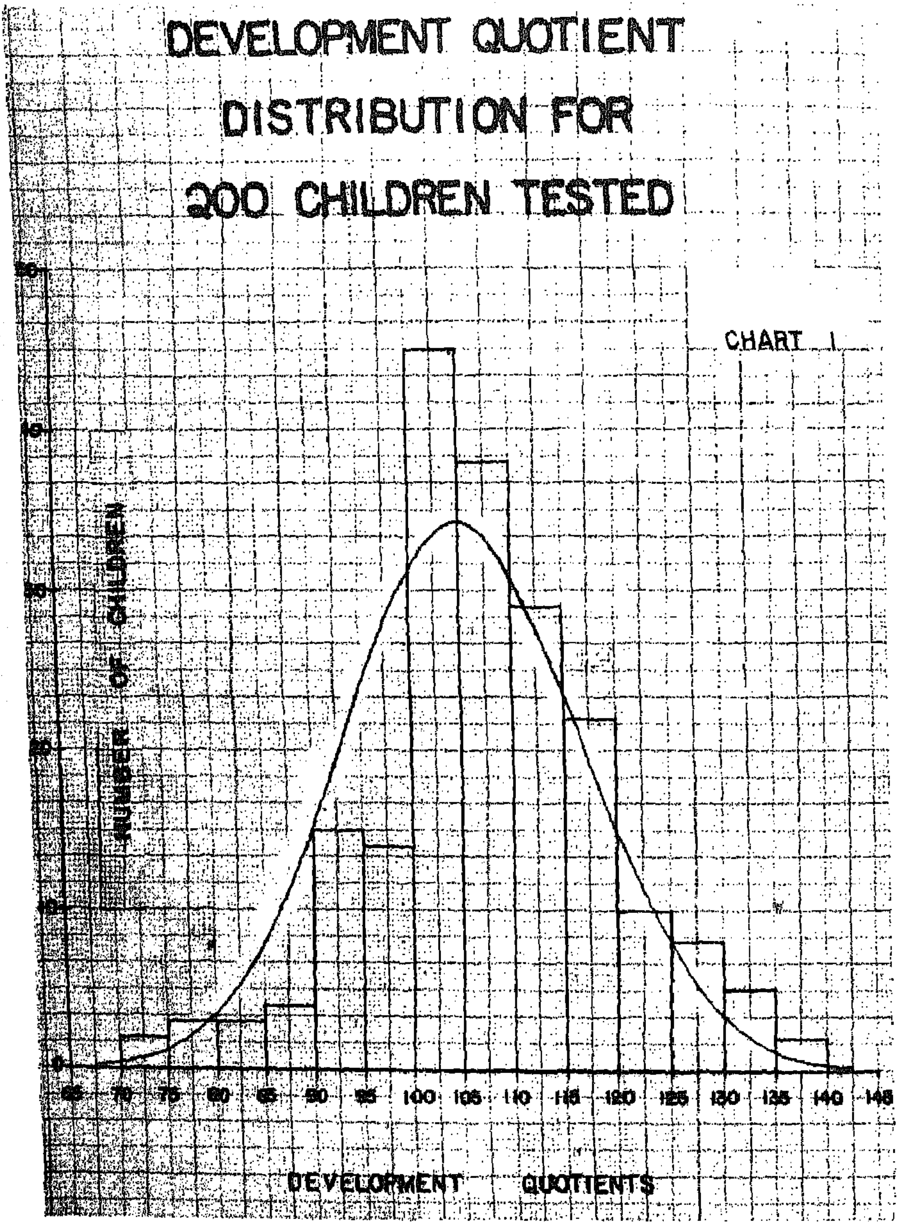
AVERAGE DEVELOPMENTAL QUOTIENTS IN FIVE CATEGORIES

Age Groups	No.	General DQ	Bodily Control	Social Behavior	Learning	Manipulation	Mental Produc.
7th	50	107.66	107.8	107.7	105.1	107.3	
8th	50	107.67	110.5	105.3	104.0	108.2	
9th-10th	50	105.9	114.2	100.8	103.8	103.3	113.8
11th-12th	50	105.44	120.5	99.9	106.3	95.6	101.7
All	200	106.67	113.2	103.4	104.8	103.6	106.1

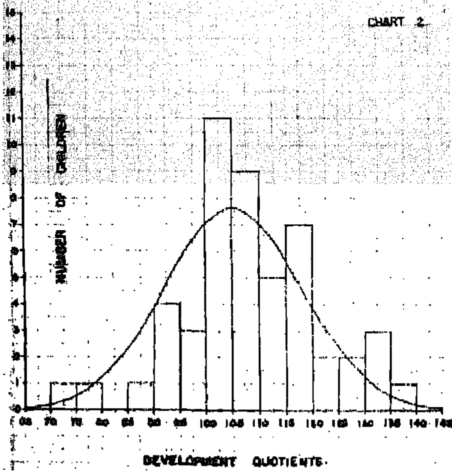
All the quotients are above 100. The test items in bodily movement are roughly one-third of all the items, and it can be seen that the very high average, 113.2, in bodily control raises the average score to 106.67. Moreover, the higher quotients for the older age groups show that the tests in bodily control were progressively easier for our subjects. In social behavior the quotient decreased in value from 107.7 to 99.9, which seems to indicate that these items are progressively more difficult. Learning quotients varied less from level to level than the others, and did not go as high or as low as the others. Fifty-nine children were able to pass some of the items in mental production and received developmental quotients in this field.

V. RELIABILITY

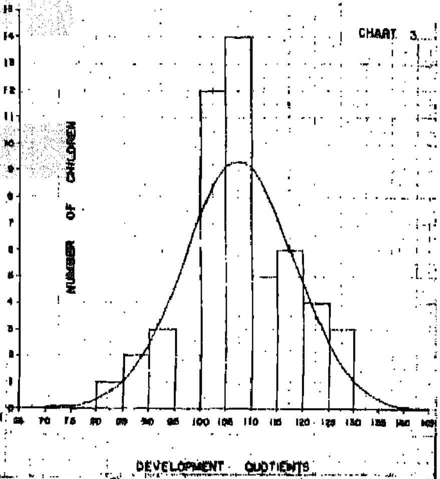
Reliability of the developmental ages was determined by splitting the odd-numbered and even-numbered developmental items, computing the Pearson product moment coefficient of correlation between the resulting


DEVELOPMENT QUOTIENT
DISTRIBUTION FOR
200 CHILDREN TESTED
CHART 1
NUMBER OF CHILDREN
50
40
30
20
10
0
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
DEVELOPMENT QUOTIENTS

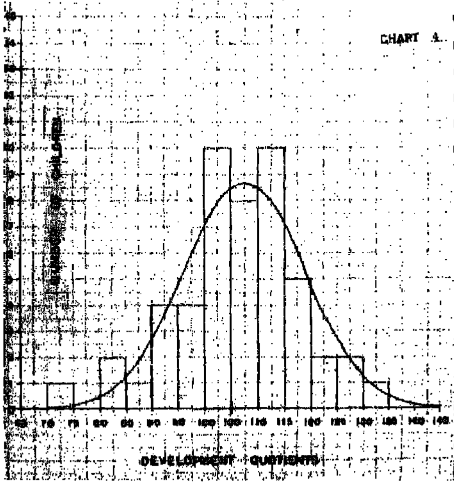
DISTRIBUTION FOR 50 CHILDREN 7 MONTHS OLD



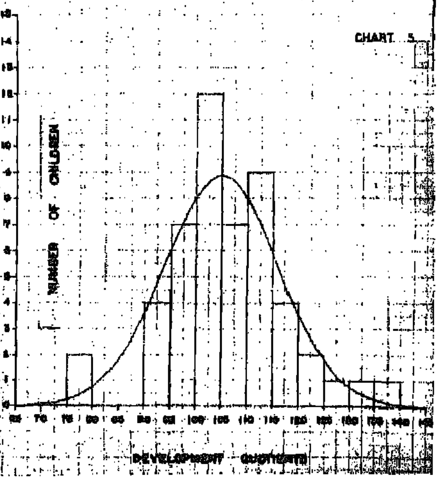
DISTRIBUTION FOR 50 CHILDREN 8 MONTHS OLD



DISTRIBUTION FOR 50 CHILDREN 9-10 MONTHS OLD



DISTRIBUTION FOR 50 CHILDREN 11-12 MONTHS OLD



DA's, and correcting the coefficient so obtained by means of the Spearman-Brown prophecy formula. Table 5, columns 3 and 4, presents these reliability coefficients based upon the 200 cases and also separately for each of the age groups. For the combined age groups the reliability coefficient was .98, with the separate age groups the coefficients ranging from .92 to .96, indicating that the test has satisfactory reliability.

As an extension of the above technique, two DQ's were computed for each individual, one based upon the odd numbered items and the other upon the even numbered items. The correlations from these DQ's were averaged for each age group of 50 children separately and for all the subjects combined. These correlations were corrected by the Spearman-Brown formula and are likewise presented in Table 5, columns 5 and 6. It must be noted that the correlations between the DQ's are spurious to some degree as are all correlations between quotients. The reliability coefficient for the whole group was .94, with a range from .90 to .96 for the separate age groups.

TABLE 5

RELIABILITY OF DA'S and DQ'S FOR VARIOUS AGE GROUPS AS
COMPUTED BETWEEN SPLIT-HALVES OF THE TEST ITEMS
AND CORRECTED BY THE SPEARMAN-BROWN FORMULA

Age Groups Months	No. of Cases	DA's Split-half Correlations	DA Correlations Corrected	DQ's Split-half Correlations	DQ Correlations Corrected
7-12th	200	.96	.98	.88	.94
7th	50	.93	.96	.93	.96
8th	50	.86	.92	.85	.92
9-10th	50	.90	.95	.90	.95
11-12th	50	.85	.92	.82	.90

A further method used for examining the reliability of the test series was the correlation of the general DA's and DQ's, with the partial DA's and DQ's in the separate categories computing their Pearson product moment coefficient of correlation and correcting the coefficient so obtained by the Spearman-Brown prophecy formula. Table 6 presents these coefficients. In connection with the low coefficient in mental production it is to be noted that only 59 subjects passed any items of this category which appears first in the last age level of this study. In general the DA reliability coefficients are higher than the DQ coefficients.

VI. GROUP DIFFERENCES

Supplementary analyses were made on the bases of descent, sex and immediate environment of the subjects. The groups compared for influence of descent consisted of 20 boys and 20 girls, 5 at each of the four age levels. Though these numbers were too few for extensive conclusions, it is interesting to see in Table 7 that the group averages were not significantly different since the lowest DQ average was 103.63 for the

TABLE 6

RELIABILITY OF THE GENERAL DA'S AND DQ'S AND THE PARTICULAR DA'S AND DQ'S, AND CORRECTION BY THE SPEARMAN-BROWN FORMULA FOR 200 SUBJECTS

Categories	Number of items in each category	Correlation bet. DA's and DA in category	DA Correlation as corrected	Correlation bet. DQ's and DQ in category	DQ Correlation as corrected
Bodily Control	37	.80	.89	.78	.87
Social Behavior	12	.93	.96	.80	.89
Learning	15	.93	.96	.80	.89
Manipulation	9	.93	.96	.62	.76
Mental Production	3	.56	.71	.33	.50

TABLE 7

DEVELOPMENTAL QUOTIENTS FOR FIVE GROUPS ACCORDING TO DESCENT

Group	DQ	Bodily	Social	Learning	Manipulation	Mental Production
British	107.15	113.5	105.3	105.45	103.55	103.9
Italian	108.23	119.4	101.55	104.6	100.3	106.6
Jewish	103.63	107.2	100.6	101.3	105.9	105.5
Nordic	107.33	112.9	104.85	105.6	104.1	105.3
Slavic	107.05	113.2	104.1	107.1	104.25	106.1
Average	106.67	113.2	103.3	104.8	103.6	106.1

Jewish and the highest was 108.25 for the Italian group. The latter owed its high general average to its high average in bodily development (119.4); in other fields, the averages were not higher than the rest. An explanation of the lower average of the Jewish children was offered in the ratings for the four pairs of twins in this group. The DQ's of these twins averaged 93.86 and did affect the group average. This is not surprising since three of these pairs of twins were prematurely born and there is a tendency for retardation in motor and posture control of prematurely born infants.

Comparisons of the quotients of boys and girls were undertaken, and Table 8 reveals no significant differences, in agreement with the findings of Buehler and others.

It may be seen in Table 9 that the 16 children living in institutions have lower averages than the group as a whole in all fields of development except manipulation. The group of 16 however is too small in comparison with the rest of the group for extensive conclusions.

A comparison of Developmental Quotients of Groups I and II of the Goodenough Socio-Economic Scale with the Average Developmental Quotients of all the subjects resulted in the scores of Table 10.

It is interesting to note that the children of Groups 1 and 2 have

TABLE 8

ARITHMETIC MEANS AND STANDARD DEVIATIONS
OF DQ'S FOR BOYS AND GIRLS SEPARATELY

	No. of Cases	Arithmetic Means	Standard Deviations
General	100 Boys	107.5	10.5
	100 Girls	106.0	13.5
Bodily	100 Boys	115.0	17.5
	100 Girls	112.0	18.5
Social	100 Boys	104.5	14.5
	100 Girls	102.4	15.5
Learning	100 Boys	104.5	13.0
	100 Girls	105.0	14.0
Manipulation	100 Boys	103.6	11.5
	100 Girls	103.8	16.5

TABLE 9

DIFFERENCES BETWEEN HOME AND INSTITUTIONAL CHILDREN

Children	DQ	Bodily	Social	Learning	Manipulation
16 in Institutions	101.44	101.7	97.6	98.0	107.8
184 at Home	107.12	113.9	103.9	105.4	103.5

higher average developmental quotients in social behavior, learning and manipulation than the 200 cases as a whole, and a lower quotient in bodily control than the group as a whole.

VII. ANALYSES AND CONCLUSIONS

In order to compare the difficulty of each separate item of the four test series considered in our study, the percentages of children passing each item were arranged in Table 11 along with the average percentages of the 200 New York subjects and the 20 Viennese children. It can be seen that the American general average 66 per cent is close to the general Viennese average 67.2 per cent.

From this study the conclusion seems warranted that the following test items are unsatisfactory: 1) Field of bodily control, 11-12th month, item 2; 2) Field of social behavior, 9-10th Month, item 5 and 6; 3) Field of manipulation, 9-10th Month, item 8 and 9; 4) Field of mental production, 11-12th month, item 10.

With the above exceptions the four Buehler test series for 6-to 12-month-old children are valuable instruments for estimating the development of American infants. As a practical instrument then the test series are satisfactory but changes in certain items are advised in order to increase their general validity.

TABLE 10

SOCIO-ECONOMIC DIFFERENCES

	DQ	BODILY	SOCIAL	LEARNING	MANIPULATION	MENTAL
Groups I & II 15 Children	108.92	109.0	109.6	108.0	113.5	107.7
All 200 Children	106.67	113.2	103.4	104.8	103.6	106.1

TABLE 11

PER CENT OF CHILDREN PASSING THE TEN TESTS AT THEIR OWN AGE LEVELS

Series Item	7th Mo. % Test	8th Mo. % Test	9-10th Mo. % Test	11-12th Mo. % Test	All % Test
1.	96 Body	84 Body	90 Body	94 Body	
2.	78 "	88 "	82 "	86 "	
3.	88 "	66 "	90 "	90 Social	
4.	48 "	80 "	44 "	70 Learning	
5.	70 "	64 "	8 Social	90 "	
6.	68 "	80 Social	50 "	30 Manipulation	
7.	56 Social	78 "	60 Learn	22 "	
8.	64 Learn	80 Learn	38 "	40 Production	
9.	60 "	62 "	36 "	62 "	
10.	66 Manip.	66 Manip.	72 Manip.	40 "	
New York Average	69.4	74.8	57.0	62.4	66.0
Vienna Average	65.4	65	69.2	69.4	67.2

VIII. SUGGESTED REVISIONS

The following improvements are suggested 1) to replace those items considered unsatisfactory and 2) to clarify the instructions for administration, where necessary.

The Seventh Month

Item (5) - Sitting with support.

A blanket is hung over the side of the bed and Subject (S) is placed in a sitting position leaning against it (not in a corner of the crib). If the child remains in this position even for one-half minute, score plus (+).

Item (7) - Actively seeking contact.

Experimenter (E) standing beside the child's crib, pays no attention to S and avoids looking at his face. If the subject attempts to make contact by cooing, etc., or if S cooperates with E during test, accepts the presence of E and enjoys the test situation, score +.

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The Eighth Month

Item (3) - Pushing away a disagreeable stimulus.

E goes through the movements of cleaning the child's nose with a piece of cotton wool. Child is in dorsal position or sitting in the lap of E. If S grasps the experimenter's hand and pushes it away from his face, score +.

Item (6) - Taking a toy away from the adult.

E places her hand in which she holds a rattle (1) within grasping distance of S in his crib. Child sits with support if necessary. If S attempts to take the toy away from E with some display of force, score +.

Item (9) - Manipulating two toys.

While S is playing with one rattle a second rattle is handed him. If S takes the second rattle without dropping the first and moves both rattles about, score +. If attention alternates from one to the other rattle, this is counted +.

Item (10) - Grasping cup by handle.

E offers S a cup as S sits with support if necessary, or on the lap of E. If S approaches the cup with both hands selecting the cup handle for grasp, score +.

The Ninth and Tenth Months

Item (3) - Sitting without support.

The child is seated in the middle of the crib without support of any kind. If S is able to hold this position for at least one-half minute, score +.

Item (4) - Crawling.

S is brought to the prone position and a favorite toy is placed before him out of reach. S moves forward by crawling. If he only rolls over sideways the item is not passed. Stomach must be off the bed, movement by knee and hands.

Item (5) - Responding to gestures or phrases or both.

E illustrates the gestures or utters the phrases or both of "bye-bye", "clap-hands", "how big", "patter cakes" or "where is the---bird, bottle or clock, etc." If S responds by specific gestures or words or both, score +.

Item (6) - Attracting the adult's attention.

E standing beside the child's crib, turns her back to him and seems occupied with other things. If S attempts to attract her attention by pulling her coat or reaching out a toy, or vocalizing, score +.

Item (8) - Imitative drumming with one stick.

E beats on the drum with one stick and hands S the stick. S imitates the movements with the stick. This item is passed when the movement is made in the air without actually touching the drum. (The actions of the first minute are counted as the criteria.)

Item (9) - Beating two spoons together.

S sits up in bed, E stands behind him and leans over, beating two spoons together before the child's eyes. She then gives the spoons to S. S takes the spoons, manipulates them and rubs them together in some fashion. The item is passed even when the child does not succeed in actually bringing the spoons together but moves them towards each other with strained attention. The actions of the first minute are again the criteria for passing.

The Eleventh and Twelfth Months

Item (2) - Standing without support.

S is asked to stand up or is placed on his feet while support is withdrawn when it is found that he can handle the situation. If S stands without support for a moment, score +.

Item (3) - Speaking two or more words or understanding commands.

E tells S in the course of the testing procedure to "get up", "lie down", or "give that to me (or mother etc.)" without making explanatory movements. If S obeys two of these commands or S speaks two or more words spontaneously, score +.

Item (7) - Putting a spoon in a cup.

E offers S a cup and spoon separately. If S puts the spoon in the cup, score +.

Item (10) - Obtaining an object from behind a screen.

A favorite toy, such as the bell or a ball is placed before the child. As soon as he reaches for it E places the screen between the child and the toy. If S does not reach round it E can show the toy on the side of the screen and then hide it again. Usually after some unsuccessful attempts to reach through the screen, S looks or reaches behind it. This test is also counted as passed when the S pulls the screen down toward himself or away to get the object.

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SOME ASPECTS OF LEADERSHIP IN AN INSTITUTION[1]

WILLIAM FAUQUIER AND JOHN GILCHRIST

In the past the historian, philosopher, and essayist have devoted much time to the consideration of great men. Only recently, however, has the study of outstanding individuals, especially leaders, become interesting to the psychiatrist and social psychologist, although as early as 1835 Quetelet laid the foundation upon which Francis Galton, Havelock Ellis, and James Cattell based their inquiries on heredity and genius.

No serious attempt has been made in this paper to compile a complete bibliography on Leadership. The authors have made a search through the abstracts of the past decade and have examined much of the literature. W. Albig (1), for instance, lists thirty-seven authors in his chapter on leadership of whom only a few have been drawn upon for application directly to the source of this study.

The process of leadership is difficult to examine because of the complexity of personality and the difficulty of controlling the complicated variables to a degree which permits accurate interpretation and prediction. Apparently leadership is the product of many interrelated factors. "The roles and functions of the leader, the characteristics of the leader and the techniques of leadership vary with the situation. Various groups, varying in size, the nature of their constituents and the group purposes and functions, require different types of leadership" (1,p.98). Frank has pointed out that the need for leadership in any field arises from the fixed, rigid, and unchangeable patterns of thought and performance by those who, by position or seniority, control affairs (15).

"The psychologist's quest for general leadership traits," Albig believes, "has been futile" (1, p. 98). But Cowley has reported a statistical study of leadership, wherein he claims to have isolated through a factor analysis method six traits common to leadership - self—confidence, finality of judgment, motor impulsion, and speed of decision (measured in three ways). Cowley's conclusions will be dealt with later in relation to interpretations made in this study.

The intelligence factor, as have other single variables, has claimed the attention of some investigators (12, 23). Others have concerned themselves primarily with age, physical index, popularity, and scholarship (21, 25). Cowley summarizes, perhaps better than others, conclusions gained from an examination of previous literature: "Leadership obviously is not a single trait but rather a complex fashioned together as a unity. An adequate appraisal of leadership would naturally reduce this complex to its individual units, and any sort of study of leadership to be of value should produce a list of traits which go together to make a leader. If one could produce an authentic list of such leadership traits, immediate and important theoretical and practical advances might be made in our understanding and control of human behavior" (7, p. 144). A study summarized in the science section of the

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[1] *This study was conducted at Berkshire Industrial Farm, Canaan, New York.*

Sunday New York Times describes the techniques used by Simoneit in the selection of German soldiers and officers (4). "The examination (of soldiers) deals with realities. It is based on intelligence analysis, expression analysis and life history. For each of these, everyday life approaches have been worked out. The method of intelligence tests has been abandoned; tasks which are en rapport with daily life are given instead. A 'leadership test' consists essentially in instructing a group of soldiers to perform some mechanical task such as making a coat hanger out of a piece of wire...' Since men can influence men only when they show themselves adequate and free, the characterological examination reaches its peak at this point,' says Simoneit" (4). This study indicates clearly the German understanding of the pragmatical aspects of situational leadership.

Then, "It becomes quite obvious that in discussing leadership or headship two parallel studies must be made - the study of individual traits and the study of situations. Every situation stresses some traits more than others, and there can be little understanding of individual traits and their relationship to headship or leadership unless these situational stresses are known and understood" (7, p. 147).

This paper deals with leadership in an institution, the Berkshire Industrial Farm. An attempt is made to describe various aspects of the leadership process. The authors are well acquainted with each leader and have had ample opportunity to observe them in many situations. Close association with this group over a period of the last four years permits them, moreover, to consider each individual from an unusually intimate point of view.

DESCRIPTION OF THE GENERAL SITUATION IN WHICH LEADERSHIP OCCURS

The Berkshire Industrial Farm is a private, home-school for problem boys between the ages of 12 and 17. Berkshire boys may be committed by any Children's Court of New York, through agencies having legal guardianship of the individual, and directly by parents or guardians from any state in the union. All boys received are legally delinquents. Thus considered, "delinquency" includes truancy, desertion of home, disobedience, lying, stealing, and behavior difficulties resulting from emotional conflicts and improper training and supervision. Serious and advanced types of juvenile delinquents are not accepted.

The mean age for commitment is 14 years. Length of stay averages nearly 2¼ years. About 64 per cent of the boys come through courts, 19 per cent from social agencies, and 18 per cent are committed privately by parents. Slightly less than 50 per cent of court cases are from New York City.

Group life in the institution is centered about the cottages, 5 in number, each accommodating 30 boys selected according to physical size, age, and social-emotional maturity. Here, under cottage parents, the boys eat, sleep, and engage in recreation suited to cottage life. Much of the group activity is scheduled in the gymnasium and on the campus. Intramural games are frequent.

Existent among the boys is more than the usual amount of loyalty to group causes which often is not conducive to the best maintenance of rules set forth by the administration as necessary for the smooth operation of the institution. On the whole, group morale and co-operation with the staff are satisfactory, but too active co-operation by a boy with the administration is generally discouraged by the group majorities who hold to the code that fidelity is first owed to the group with whom the individual associates. On the other hand, this tie is not so strong that weak boys frequently suffer at the hands of the aggressive, especially when the reasons which have provoked tension or conflict are not considered "just" by the group.

The physical plant lies in the heart of 1100 acres in the Berkshire Hills. Buildings are scattered over a half square mile and there are no guards or walls to keep the group restricted to any section. Facilities and general plan resemble those of a good middle class boarding school. For an institution of its type, considerable freedom of movement and room for individuality are allowed its boys.

METHOD

Some 119 subjects filled out a four page, twenty-eight item questionnaire. Names of cottage leaders were obtained, as well as other data describing the leaders and each boy's leanings concerning his own fitness and aptitude for leadership. The following are typical of the questions asked:

1A Who would you say are the three most important leaders in your cottage? Name the three in order of their importance, power, and influence among the boys. They may or may not be your friends; you may even dislike them. Be honest because accuracy in this paper counts. In case you are a leader, and know it, put your name down.

6A Have you noticed how the boy you chose as the most important leader pays attention in school and to what boys and staff say to him? (Check sentence best describing him.)
Very alert, awake, and attentive most of the time.
Seems in a fog much of the time; pays poor attention.
Neither very awake nor very inattentive.

1B Do you have a special group of friends whom you "pal around with" a lot?
Yes
Sometimes
No

9B What do you think makes a leader? Is it the way he acts? The way he was born? The way he thinks? Or the way he gets things over? (Check one which shows what you think makes a leader.)
Leaders are born.
Leaders do things and "stand for" things you admire.
They are strong and kick fellows around.
They are tough and protect you.
They force their way into leadership; you can't stop them.
They know the "answers" and it pays to stick to them.

For each boy included in the study his housemother and teachers filled out a rating scale showing the position for each of eight personality traits along an agressive-normal-submissive continuum. Section A of the questionnaire administered to the boys closely duplicated the staff rating scale so that there were available estimates of the leaders by 1) the group which chose them, and 2) the staff who observed them.

RESULTS AND DISCUSSIONS

From the following accumulated data representing several variables inherent in the individual and/or in the situational aspects of group life, the matter of leadership was studied in an attempt to discover the leaders and to describe them. Because of the importance of this subject and its bearing on morale, some attention has also been given to a brief consideration of the processes of leadership in general; for concentrated in this institution are many of the factors which operate in various other societal relationships, particularly those in which exists a somewhat rigid system and attendant forces which frequently create unusual tensions.

Leadership often shows itself early in a boy's career. Garcia indicates that before age 5 there can hardly be any leadership; that from ages 5 to 8 it remains in a rather undeveloped form, becoming better defined after the 9th year. At puberty children are more decided, better developed, and better organizers (19). Normal children quickly discover the most suitable level of aggression and the role which gives them the most satisfaction - either that of submission or of dominance (2, 11). The 'delinquent' boy, it appears, has unusual difficulty in selecting the most advantageous role. At either extreme problems arise, and the quality of leadership created in any situation obviously is related to each individual's adjustment. It has been suggested by Dollard that aggression when inhibited by social pressure and the fear of punishment often shows a tendency to become displaced or to show itself indirectly. "On occasion, displaced aggression may even serve socially approved ends" (10, p. 42). Possibly leadership in the instance of a problem boy in an institution may be thought of as evidence of displaced aggression. Certainly the leaders' greater degree of ascendancy strongly suggests this possibility.

For the sake of brevity and sharper focus, the data obtained are summarized in this paper.

The data of Table 1 show the leaders to be older, of longer residency, taller, and heavier. These findings are in accordance with other investigators (21, 23, 17, 25). They rate, however, lower in intelligence, which is contrary to the conclusions of others (21, 23, 17). Interestingly, the leaders have a significantly lower misconduct count and appear better adjusted than their followers.[2] This is corroborated by the data of Table 4.

Selection of the leaders by the boy group was conducted as follows: three points were credited to an individual listed as first choice, two

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[2] *Misconduct for six months previous to time of study.*

TABLE 1

MEAN LENGTH OF RESIDENCE, AGE, VERBAL AND NON-VERBAL INTELLIGENCE QUOTIENTS, NUMBER OF MISCONDUCT REPORTS FOR "AVOIDANCE OF RESPONSIBILITY," NUMBER OF MISCONDUCT REPORTS FOR "ANTI-SOCIAL AND INFANTILE BEHAVIOR:"[3] MEAN HEIGHT AND WEIGHT FOR LEADERS AND FOLLOWERS

	Mean	
	Leaders	Followers
Number in group	29	90
Chronological age in months	185.41	173.05
Length of residence in months	19.65	15.07
Binet I.Q.	96.20	100.65
Chicago Non-Verbal I.Q.	96.20	95.60
Number of reports for "Avoidance of responsibility"	8.00	15.16
Number of reports for "Anti-social and Infantile Behavior"	6.10	9.31
Height in inches	66.32	60.86
Weight in pounds	124.50	104.35

points as second choice, and one point as third choice. Twenty-nine boys, credited with 638 points or 97 per cent of the total points were arbitrarily accepted as leaders. Table 2 shows the ratings of the staff compared to ratings of the followers.

The data of Table 2 raise the question as to the validity of the staff ratings upon which many of the conclusions in this study are drawn. A general tendency by staff members to overrate considerably the ascendant traits of leaders compared to ratings by the followers is noticeable, the boys - perhaps because of bias - tending to think of their comrade leaders as being more strictly normal in most cases. These discrepancies may be accounted for in two ways. First, the standards of aggression and submission appear to be primarily different for the two groups of raters. Second, the boys are not trained in making accurate quantitative discriminations of personality traits, especially through a medium of measurement which in some instances they may not well comprehend.

To check the statistical reliability of the rating scale used by the staff a quantitative scoring was devised as follows: three points for each trait given an aggressive rating, two points for a normal rating, and one point for a submissive rating. This provided a possible point score from 10 to 30 in terms of degree of ascendancy shown.

The most interesting discrepancy between the two groups of raters was in their selection of leaders. Assuming that the boys are 100 per cent accurate, at least in recognizing the leaders within their special groups, it was found that the teachers selected only 39 per cent and the house-parents only 27 per cent of the 29 leaders indicated by the boys. This difference strongly suggests that leaders are not easily recognizable by even competent observers. G. W. Allport suggests that leaders

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[3] *A daily record of misconduct is kept for each boy and tabulated according to type every month. This affords a valuable objective criteria for the quantitative measurement of behavior. The procedure has been described in detail in three earlier studies (11, 12, 13).*

TABLE 2

ASCENDANT AND SUBMISSIVE TRAITS OF BOYS CHOSEN AS LEADERS RATED BY STAFF AND BY THEIR FOLLOWERS

Trait Rated	Percentage Rated as Being	
	By Staff	By Boys
Ascendant Traits:	(41.0)	(20.4)
Actively resistant	15	9
Generally aggressive	52	11
Bold in relations with adults	30	13
Very alert and attentive	56	26
Actively cooperative	59	28
Attention getter	41	27
Excitable, temper, etc.	45	23
Impulsive in behavior	30	26
Submissive Traits	(11.1)	(20.0)
Passively resistant	7	23
Generally submissive	19	19
Timid in relations with adults	11	11
Inattentive, dissociated	11	11
Passively cooperative	15	40
Withdrawn, day-dreamer	4	10
Phlegmatic, even tempered	15	13
Planful and cautious in behavior	7	33

TABLE 3

MEAN, PROBABLE ERROR OF MEAN, AND PROBABLE ERROR BETWEEN THE MEANS OF THE POINT SCORES ON THE RATING SCALE FOR THE LEADER AND FOLLOWER GROUPS

Group Rated by Staff	Mean Aggressive Score	Probable Error of Mean	Probable Error Between 2 Means
Leaders	21.78	0.326	6.37[4]
Followers	19.23	0.227	

do not necessarily have to be ascendant and that less outgoing leaders may frequently have more aggressive boys who act as their intermediaries (2, p. 144). Certainly there are many situations in which face-to-face or direct control does not operate, although the general indication is that leaders are more dominant and aggressive.

Albig suggests that, "The leader appears as master of the situation. He is dominant and assured" (1, p. 100). Certainly the leaders chosen by the boys and rated by the staff show considerably more dominance. They are more alert, aggressive, cooperative with powers they recognize, show considerably more impulsiveness, excitability, and desire to hold the center of attention. This corroborates Cowley's conclusions that

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[4] *This probable error between the two means satisfies the rule that a difference or a statistical constant of any sort must be at least four times its probable error to be considered significant.*

TABLE 4

STAFF RATINGS OF LEADERS COMPARED WITH FOLLOWERS

Trait Rated By Staff	Percentage Rated as Being	
	Leaders	Followers
Ascendant Traits	(41.0)	(28.0)
Actively resistant	15	21
Generally aggressive	52	42
Bold with adults	30	29
Very alert and attentive	56	28
Actively cooperative	59	24
Attention-getter	41	31
Excitable, temper, etc.	45	33
Impulsive in behavior	30	16
Submissive Traits	(11.1)	(27.2)
Passively resistant	7	20
Generally submissive	19	26
Timid with adults	11	26
Inattentive, dissociated	11	30
Passively cooperative	15	31
Withdrawn, day-dreamer	4	25
Phlegmatic, even tempered	15	21
Cautious, planful in behavior	7	39

self-confidence, finality of judgment, motor impulsion, and speed of decision are factors essential to leadership. The situational factors should not, however, be lost sight of. Perhaps leadership in an institution for delinquent boys calls for greater physical ability, alertness, aggression, excitability, and other ascendant expressions than would be necessary in groups elsewhere - boys' clubs in churches, Boy Scouts, etc. Lewin, Lippitt, and White (18) indicate that the type of restricted environment, peculiar to institutions, characteristically produces more aggressive behavior than would be expected of individuals in a more democratic and less regulated environment.

It is certain that considerably greater intensity of frustration is daily present among problem boys in strictly controlled situations than among "normal boys" living in society. If so, it probably follows that displaced aggression finds its outlet in leadership (10, p. 42) which stresses the traits previously emphasized (10).

TABLE 5

SOME SELF RATINGS OF LEADERS AND FOLLOWERS

Question Asked	Percent Affirmative Reply	
	Leaders	Followers
Do you have a special group of friends?	38	51
How frequently are you chosen captain?[5]	73	40
Do you like living in an institution?	86	68
Are you a leader?	55	17

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[5] *In a previous study (12) it was reported that a higher number of* ***aggressive*** *boys preferred competitive group games than did* ***submissive*** *boys.*

The data of Item 1, Table 4 seem to prove greater extroversion, security, and feelings of self-adequacy by the leaders. Bogardus has suggested that the holdings of associates at a distance by persons of ability may be a leadership trait (5). Ries (26) believes that physiological components (which work in the production of frustration) are important in leadership. Leaders have fewer affective attachments, admit themselves to be more frequently chosen as leaders, recognize their own qualities of leadership better, and seem less frustrated by competitive group living. Perhaps they are able to reconcile their lot in the group more effectively through leadership.

Nafe (20) quotes Goethe as describing the leader as a konnig man (a man who can) and stresses both the situational aspects of leadership and the "emotional set" which motivates some people to leadership. This further suggests that leadership, like play habits, has "the most intimate affective connections with the highly elaborated tissue-needs of the individual" (12, p. 124).

Further descriptive data were furnished by the last section of the questionnaire. Some 45 per cent of followers rate leaders as being "tough, handy with their fists, and honest;" 44 per cent think of them as "honest, regular fellows." This seems to preclude the possibility that leaders in this institution attain their control through fear and physical dominance. Albig warns that "Leadership (1, p. 96) must be distinguished from domination (See Reference 24), the leader from the headman (7); leadership must be distinguished from coercion (27), power from power over" (14).

In 59 per cent of instances the followers describe leaders as "clean cut fellows who do their best to get along;" 22 per cent as a fellow "who shows interest and helps you;" 20 per cent as a fellow "who knows the answers and it pays to stick to." The need for security, common in various degrees to all people, is perhaps more accentuated in the problem boy by the uprootings which invariably have occurred before he reaches an institution. In many instances, the institution is the last attempt at rehabilitation. Here the delinquent boy immediately and continuously seeks for emotional rapport or tie-up. Older and more dominant individuals often furnish this necessity. To illustrate this point, 57 per cent of the followers describe the leader as "a fellow who does things and stands for things you admire." These 'things', of course, undoubtedly contribute to the followers' sense of security and adequacy.

In a number of instances the leader quite clearly symbolizes the frustration of the followers. Some 39 per cent of the followers admit admiring leaders because it gives them "a feeling of importance;" 30 per cent believe leaders "are smarter" than they; about 17 per cent resent the leader and voice their hostility against him. It is also noteworthy that 17 per cent of the followers believed they were leaders although their group did not list them as such.

SUMMARY

The statistics and conclusions of this study meet the test of practical observation. After four years of uninterrupted observation of boys in this institution, the authors note that many factors emphasized by the study appear to be operating in the daily lives of the subjects. Individual and group tension highlight the bully and the egocentric as producers of trouble and unrest rather than the boys accepted as leaders.

That dominance, aggression, boldness, impulsiveness, excitability, and alertness find their most frequent expressions in the personality of the leader are facts inherent in the results of this study and in the observation of the activity of the boys. This study suggests paradoxically that it is with the socially acceptable leader whom frequently adults do not recognize that morale and group control rests and through whom it may most positively be manipulated.

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A STUDY OF HEIGHT IN WHITE SCHOOL CHILDREN FROM 1937 TO 1940 AND A COMPARISON OF DIFFERENT HEIGHT-WEIGHT INDICES

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In two previous papers (1, 2) the trend of body weight has been discussed for white school children of Hagerstown, Maryland, for the successive calendar years 1933 through 1940, and in the two four-year periods, 1933 to 1936 and 1937 to 1940. The results were compared with the findings of Palmer (3, 4, 5) for a preceding period (1921 to 1927) in the same community. The main results in brief were as follows: There is to be observed a distinct secular upward trend in weight for all age groups and for both sexes. For boys the mean increase of body weight during the eight years 1933-1940 is apparent in every age (though not to the same degree), and is statistically significant for each group from 6 to 15 years. For girls the weight increase is beyond the limits of mere chance fluctuation in the lowest age group, 6-7 years, and for those above 9 years.

Whatever the reasons may be, the tendency towards an increase of growth is world-wide and, for example, has been reported recently from Zürich, Switzerland (6) for a period covering almost the same years, 1934 through 1939, as the new growth studies in Hagerstown. This secular tendency has been observed throughout the United States in different geographical regions, racial stocks, and socio-economic groups and recently reviewed by Meredith (7, 8).

It will be of special interest now to discuss the behavior of stature for the white school children in Hagerstown. Measurements regarding height have become available for four successive calendar years, 1937-1940. The observational data covering this period comprise a total of 19,949 height measurements, 10,065 on boys and 9,884 on girls. The measurements have been taken each year, together with the weighings, within the first half of May. The age has been taken as of the last birthday before the date of examination, assumed to be May 1, as described in greater detail in the former papers.

The measurements after the children discarded shoes have been recorded in centimeters. The number of children measured in each of the successive years, 1937 to 1940, is given in Table 1, which also shows the age range of the children. Since the age distribution of boys and girls is practically the same as given in the last paper (2) for the children weighed in Hagerstown, the single numbers need not be repeated.

By far the largest part of the measurements was taken on children 6 through 16 years of age, namely 9,794 on boys and 9,608 on girls. For the older pupils, 17 years of age and up, there were available only 271 and 276 measurements on boys and girls, respectively: all taken in the last calendar year, 1940. Thus the values obtained for the older Hagerstown school children are not yet as representative as are those for the younger ages.

TABLE 1

NUMBER OF BOYS AND GIRLS MEASURED IN
HAGERSTOWN, MD. 1937 to 1940

Year	Boys	Girls	Total	Age Range
1937	2,106	2,045	4,151	6 - 16 years
1938	2,367	2,378	4,745	6 - 16 years
1939	2,548	2,422	4,970	6 - 16 years
1940	3,044	3,039	6,083	6 - 20 years
All Years	10,065	9,884	19,949	

THE TREND OF STATURE IN WHITE HAGERSTOWN SCHOOL CHILDREN FROM 1937 THROUGH 1940

In Table 2 the means of body height and their standard errors are given by age and sex for the four successive calendar years. The weighted average of the whole four-year period is added also and may be considered to represent a standard of stature for the group under observation. Of course, for the reasons mentioned before this can be assumed only of the school children 6 to 18 years of age.

It is quite evident that in no age group of the two sexes is there any systematic secular trend in height. All the variations in the single calendar years lie within the limits of chance fluctuation, mostly within a single standard error. This can be easily verified in each instance if the mean heights from year to year are compared with the average height for 1937-1940. Thus the results with regard to height are very different from what has been found for weight (2). Average height of children of the same age did not vary significantly in the four years under observation, whereas for weight there was a distinct upward trend observable even in this short time period. Of course, in such a short period not much change in average height can be expected since stature is less affected by minor environmental factors than is body weight.

Sex Difference in Height and Weight. Another point worth mentioning is the well-known sex difference in body height at different ages. This is shown by plotting the height averages for the total period 1937-1940 (Graph 1).

In the ages from 6 to 10 years the sex differences are small, the boys being somewhat taller than the girls. The curve for girls crosses the one for boys before 11 years of age is reached and at the ages 11 to 13 years, the girls significantly exceed the boys (by 1.4 to 2.5 cms. in the three age groups). Immediately before the 14th year of life is completed the curve for females cuts again that for males and remains below for all the subsequent ages. At the age 14-15 years, or the mid-point of this interval, 14½ years of age, the sex difference amounts to exactly 2 cms.; at 15-16 years, it amounts already to 5.8 cms., and at 16-17 years of age to almost 10 cms. The findings are in good agreement with those of former investigators (for instance B.T. Baldwin (9), Collins and Clark (10), Steggerda and Densen (11). It may be further of

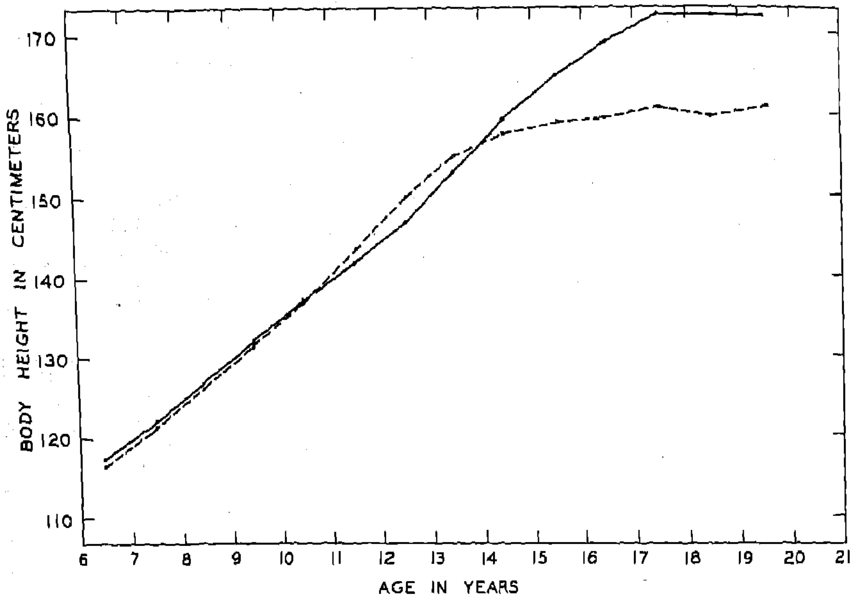
TABLE 2

MEAN STATURE IN CMS. OF BOYS AND GIRLS MEASURED IN HAGERSTOWN, MD. 1937 to 1940

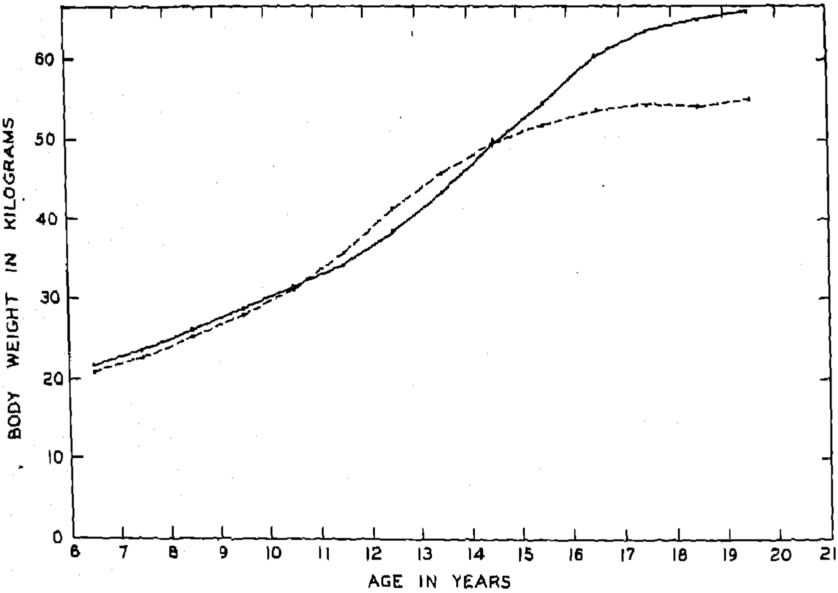
Age in years	Boys				
	1937	1938	1939	1940	1937-1940
6-	117.1 ± .46	117.9 ± .43	117.0 ± .37	116.7 ± .46	117.2 ± .21
7-	121.4 ± .42	121.8 ± .36	121.5 ± .38	121.6 ± .35	121.6 ± .19
8-	127.2 ± .40	127.1 ± .40	126.2 ± .37	127.2 ± .39	126.9 ± .19
9-	132.3 ± .38	132.0 ± .41	131.9 ± .41	132.6 ± .41	132.2 ± .20
10-	136.9 ± .39	137.1 ± .35	136.7 ± .43	137.5 ± .43	137.1 ± .20
11-	141.7 ± .44	141.6 ± .40	141.6 ± .38	142.1 ± .42	141.8 ± .20
12-	146.8 ± .46	146.8 ± .47	146.7 ± .42	147.7 ± .45	147.0 ± .23
13-	153.6 ± .48	153.7 ± .50	151.8 ± .50	153.3 ± .49	153.1 ± .25
14-	158.5 ± .70	160.6 ± .53	160.0 ± .50	159.0 ± .52	159.6 ± .27
15-	163.6 ± 1.02	164.3 ± .74	165.3 ± .59	164.9 ± .52	164.8 ± .33
16-	166.2 ± 2.45	167.6 ± 1.05	167.3 ± 1.16	170.1 ± .51	169.1 ± .43
17-				172.7 ± .62	
18-				172.3 ± .67	
19-				172.6 ± 1.17	
20-				174.9 ± 1.44	
	Girls				
	1937	1938	1939	1940	1937-1940
6-	116.5 ± .49	116.8 ± .41	115.8 ± .36	116.6 ± .42	116.4 ± .21
7-	121.5 ± .38	121.4 ± .35	120.7 ± .36	120.6 ± .32	121.0 ± .18
8-	126.0 ± .33	126.4 ± .38	126.3 ± .39	126.6 ± .40	126.4 ± .19
9-	132.6 ± .43	131.3 ± .36	131.3 ± .39	131.6 ± .41	131.7 ± .20
10-	136.9 ± .45	137.7 ± .43	136.0 ± .38	136.9 ± .44	136.9 ± .21
11-	143.8 ± .49	142.8 ± .47	143.0 ± .48	143.2 ± .46	143.2 ± .24
12-	149.4 ± .42	150.1 ± .48	149.0 ± .50	149.6 ± .49	149.5 ± .24
13-	154.6 ± .42	154.8 ± .38	154.5 ± .40	154.8 ± .45	154.7 ± .20
14-	156.5 ± .47	158.1 ± .34	157.5 ± .34	157.8 ± .37	157.6 ± .19
15-	158.1 ± .75	159.0 ± .44	158.1 ± .45	159.8 ± .34	159.0 ± .22
16-	155.8 ± 1.88	160.2 ± .93	159.1 ± .75	159.5 ± .37	159.4 ± .31
17-				160.7 ± .43	
18-				160.1 ± .63	
19-				160.8 ± 2.01	

interest to note that, as Steggerda found, the decussation points of the male and female curves are approximately the same for different races although in his study, for instance, the Maya Indians are about 10 cms. shorter for each age of childhood than the Navajo Indians, and still shorter when compared with the Dutch White and Negro children of the same ages (12).

It may be recalled from the former growth study (1, 2) on weight of the same generation of school children in Hagerstown that the behavior of the sexes regarding body weight was similar. Although the growth rates for height and weight are very different (weight is increasing with age much faster than height), the sex differences resemble each other closely for both measurements. This is shown in Graph 2 in which the average weights for the same period of observation are plotted. The values in pounds, as reported in the former study (2), are converted here into kilograms. The number of weighings approaching 20,000 for the



Graph 1. Mean stature in cms. of white boys —— and girls ---- measured in Hagerstown, Maryland, based on 19,402 measurements, 6 to 16 years of age, average of 1937/1940,547 measurements, 17 years of age and up, 1940 only.



Graph 2. Mean weight in kilograms of white boys —— and girls ---- in Hagerstown, Maryland, based on 19,450 weighings, 6 to 16 years of age, average of 1937/1940, 547 weighings, 17 years of age and up, 1940 only.

four calendar years, 1937-1940, was almost the same as that of height measurements described above.

As shown in Graph 2, from 6 to 10 years of age the girls are somewhat below the boys in body weight, yet the differences are small. Shortly before the age of 11 years is reached the female line crosses the male curve and stays above for the following three age years, up to 13-14 years of age, when the girls exceed the boys in weight by 2.4 kilograms on the average (more than 5 pounds). It was very much the same with regard to height in these three years. At the age group 14-15 years, the mean body weight is practically the same for the two sexes, 49.3 ± .30 kilograms for boys and 49.4 ± .28 kilograms for girls. Soon after the midpoint of this age group, 14½ years, the curve of the girls crosses again the curve of the male sex and remains then permanently below. The only minor difference between the growth patterns in height and weight is that the curve of the female sex approaches that of the males somewhat earlier for stature than for weight, the crossing-over being for height at nearly 14 years, for weight soon after 14½ years of age.

This deviation from the general uniform behavior of the sex difference may be reasonably explained by the fact that the girls at age 14 (or more exact when they have completed this year of age) in the majority have already filled out the figure and, therefore, outweigh the boys of the same stature. For ages above this, the boys considerably surpass the girls in mean body weight as in height. For the growing ages as a whole, and therefore the physiology of growth, the conclusion seems to be safe that it is not so much the sex that determines the weight but rather the height of a growing person be it a boy or girl. Only in a short period of prepuberty sex, independent from the stature reached, plays its part.

The striking parallelism in the behavior of the sex difference regarding height and weight is further to be realized, when a Female/Male Index for both characteristics is computed as shown in Table 3.

The sex ratio, of course, will vary in the different age groups within the following limits: Female/Male Index $\lesseqgtr 1$. Therefore, by taking the male sex as the unit, the index value approaches 1 when the sexes are alike; the index is less than 1 if the female is shorter or lighter than the male; it is more than 1 if the female becomes taller or heavier than the male for the respective measurements. Thus the sexual dimorphism can be easily demonstrated in respect to each quality of bodily dimensions (13, 14). The following table makes it evident that in each age group there is perfect concordance of the index values for height and weight in so far as these values are either below or above 1, except in the age group 14-15 years. For this age group the girls are already distinctly smaller than the boys (the Female/Male Index being .987) but still somewhat heavier (the F/M Index being slightly above 1). If we interpolate the tabulated values for the exact point of 14 years of age on the assumption of an even distribution within the neighboring groups (13-14 and 14-15 years of age), a Female/Male Index of .999 is obtained for height and of 1.029 for weight. Thus the girls at the completed 14th year of age are still as tall as the boys of the same age, but according to the weight index they are distinctly heavier.

Variability of Height as Compared to Weight. To obtain a view of the height variability during the growing ages Table 4 shows the standard deviations of the mean stature for the single calendar years from 1937 through 1940 and the weighted standard deviation for the period as a whole.

TABLE 3

FEMALE/MALE INDEX FOR HEIGHT AND WEIGHT FROM 6 TO 19
YEARS OF AGE OF WHITE SCHOOL CHILDREN IN
HAGERSTOWN, MD., 1937 TO 1940*

Age in Years	Height	Weight
6-	.993	.968
7-	.995	.958
8-	.996	.965
9-	.996	.969
10-	.999	.994
11-	1.010	1,029
12-	1.017	1,065
13-	1,010	1,055
14-	.987	1,002
15-	.965	.952
16-	.943	.886
17-	.931	.857
18-	.929	.832
19	.932	.834

* 17-19 years of age, only 1940

TABLE 4

STANDARD DEVIATION OF STATURE (CMS.) OF WHITE SCHOOL
CHILDREN IN HAGERSTOWN, MD., 1937 TO 1940

Age in years	Boys					Girls				
	1937	1938	1939	1940	1937-1940	1937	1938	1939	1940	1937-1940
6-	5.3	4.9	4.9	5.3	5.1	5,2	5.1	4.7	5.2	5.0
7-	5.6	5.5	5.9	5.4	5.6	5.4	5.1	5.4	5.4	5.3
8-	5.9	5.9	6.0	6.1	6.0	5.1	5.7	5.8	6.3	5.7
9-	6.0	6.2	6.5	6.7	6.3	6.7	5.7	6.0	6.5	6.2
10-	6,2	5.8	6.7	6.8	6,4	7.0	6.9	6.1	6.9	6.7
11-	7.0	6.6	6.3	6.8	6,7	7.7	7.4	7.8	7.0	7.5
12-	7.9	7.6	7.2	7.6	7.6	7.0	8.0	7.9	8.1	7.7
13-	7.8	8.5	8.3	8.6	8.3	6.5	6.5	6.8	7.3	6.8
14-	9.1	8.5	8.9	8.6	8.7	6.2	5.5	5.8	6.2	5.9
15-	8.5	9.1	7.7	9.0	8.6	5.4	5.5	5.8	5.9	5.7
16-	11.2	7.4	8.2	7.5	7.8	6.0	5.5	5.5	5.5	5.5
17-				7.7					5.7	
18-				5.9					5.9	
19-				6.1					8.5	
20-				5.4						

The variability of height during the single years of observation presents no consistent trend for children of the same ages. However, it will be seen that there is an upward trend with age from 6 to 15 years for boys and from 6 to 12 years for girls. (See also Baldwin (9), Palmer and Reed (15)). Considering only the averaged values of the four-year period 1937-1940, the standard deviation increases in boys from 5.1 cms. in the age group 6-7 years to 8.7 cms. in the age 14-15 years. After the age 15-16 variability of height decreases again. In girls the standard deviation of height rises from 5.0 cms. in the youngest age group, 6-7 years, to 7.7 cms. in the age group 12-13 years, then decreases slowly from this prepuberty stage on.

To demonstrate the differing variability of height and weight with increasing age, in Table 5 the averaged values of the standard deviation and the relative parameter of variability are contrasted.

TABLE 5

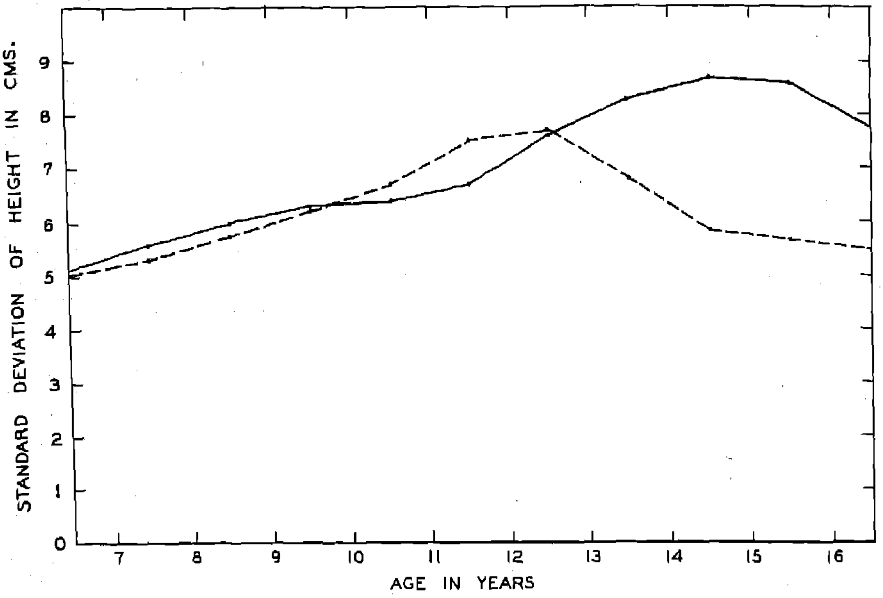
STANDARD DEVIATION AND COEFFICIENT OF VARIATION OF HEIGHT AND WEIGHT, WHITE SCHOOL CHILDREN OF HAGERSTOWN, MD. IN THE AVERAGE OF 1937 TO 1940

Age in years	Height		Weight		Height		Weight	
	Standard deviation (cms.)	Coefficient of variation (per cent)	Standard deviation (kgs.)	Coefficient of variation (per cent)	Standard deviation (cms.)	Coefficient of variation (per cent)	Standard deviation (kgs.)	Coefficient of variation (per cent)
	Boys				Girls			
6-	5.1	4.3	2.8	13.0	5.0	4.3	2.5	12.0
7-	5.6	4.6	3.4	14.4	5.3	4.4	3.1	13.7
8-	6.0	4.7	4.0	15.4	5.7	4.5	3.8	15.1
9-	6.3	4.8	4.4	15.3	6.2	4.7	4.7	16.9
10-	6.4	4.7	4.8	15.3	6.7	4.9	6.4	20.5
11-	6.7	4.7	5.8	16.8	7.5	5.2	7.9	22.0
12-	7.6	5.2	7.3	19.0	7.7	5.2	9.4	23.0
13-	8.3	5.4	8.7	20.0	6.8	4.4	9.3	20.3
14-	8.7	5.5	9.7	19.7	5.9	3.7	9.0	18.2
15-	8.6	5.2	10.2	18.8	5.7	3.6	8.6	16.6
16-	7.8	4.6	11.2	18.6	5.5	3.5	9.2	17.2
17-*	7.7	4.4	8.8	13.9	5.7	3.5	8.1	14.9
18-*	5.9	3.5	9.1	14.0	5.9	3.7	9.5	17.6
19-*	6.1	3.5	8.8	13.3	8.5	5.3	11.8	21.4
20-*	5.4	3.1	14.8	21.1				

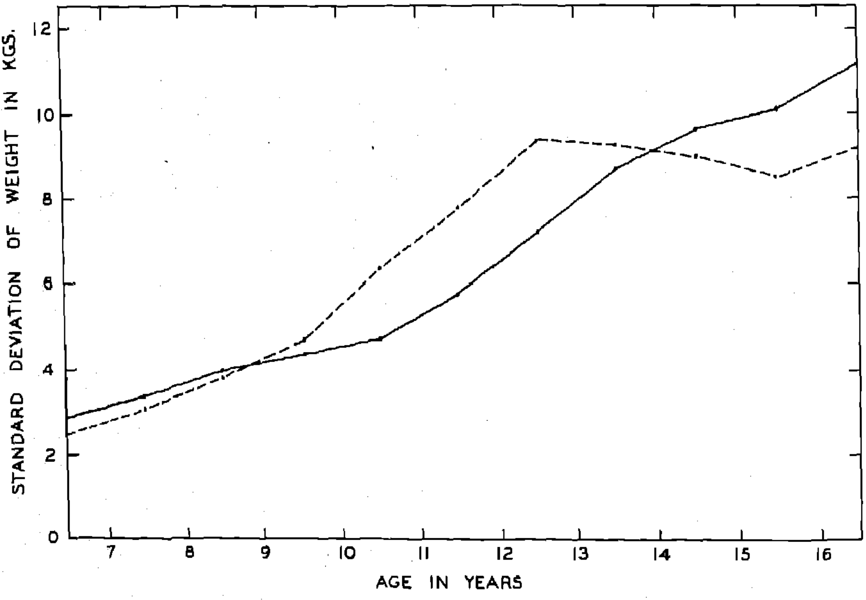
*1940 only

It is evident that the variability of body weight is in every age group and in both sexes considerably larger than the variability of body height. This consistent difference over all ages is more clearly demonstrated by the relative values of variation than by the absolute values of the standard deviation. Whereas the standard deviations of weight (in kilograms) are partly smaller and partly larger than the standard deviations of height (in centimeters), the relative values of variation are consistently in all ages higher for weight. The different variability is illustrated in Graphs 3 and 4 which show the standard deviations of stature and body weight from 6 through 16 years of age; omitted from the graph are the latter ages for which the numbers are very small and the biometric constants, therefore, not yet sufficiently representative.

The analysis of the last data brings out the sex difference in the variability of height and weight. In spite of a widely differing range of the plotted values, the biometric constants of variation in both height and weight of the two sexes show a very similar trend. This is much like the mean heights and weights themselves in the course of the



Graph 3. Variability of stature in white school children, Hagerstown, Maryland, standard deviation (average of 1937-1940) for boys —— and girls ----, 6 to 16 years of age.



Graph 4. Variability of body weight in white school children, Hagerstown, Maryland, standard deviation (average of 1937-1940) for boys —— and girls ----, 6 to 16 years of age.

growing years and is a relatively new observation. It will be seen from the tabulated values (Table 5) and from the graphs that in the ages from 6 through 9 years the parameters of variability in height are somewhat greater for boys than for girls; it is the same with regard to weight for the school years, 6 to 8. Then follows a period in which the variability in height and weight is greater for girls than for boys; it is so for height in the years from 10 until the midpoint of the 13th year, for weight from 9 years of age up to almost the end of the 14th year. Thus the greater weight variability of the girls starts one year earlier and closes one year later as compared with height variability.

After the decussation points, between 12 and 13 years of age for height, and between 13 and 14 years of age for weight, all four variability constants begin distinctly to decrease. Some later irregularities of the variability trends during sexual maturity may be due to chance fluctuation on account of the small numbers involved. However, the greater weight variability of the girls, from 17 years on, than of the boys may indicate a wider variation of mean weight in the female sex after sexual maturity has been reached and growth in stature has been finished.

The Height-Weight Ratios as an Index of Body Build. To close the separate considerations for mean body weight and stature and the age trend of variability presented in the present and preceding papers for the white school children of Hagerstown, it might be worth while to relate body weight to stature by some sort of an index of body build during the growing years. This is possible for the period, 1937-1940, in each year of which both measurements for the same generations of school children are available.

The results as obtained on basis of the means by three different indices (Quetelet index or "centimeter-weight" $= \frac{\text{Body weight}}{\text{Stature}}$; Davenport-Kaup index $= \frac{\text{Body weight}}{\text{Stature}^2}$; Livi-Rohrer index ponderalis $= \frac{\sqrt[3]{\text{Body weight}}}{\text{Stature}} \times 100$ or $\frac{\text{Body weight}}{\text{Stature}^3} \times 100$) are given in Table 6, after the conversion of pounds to the metric system. Of these body weight-stature ratios, the old Quetelet index has the clearest and simplest meaning stating only how many units of mass (grams) in a given individual or an average group correspond to a unit of stature (centimeter). We will not go into more details about the much discussed concept of a suitable height-weight index for determining children's physical development; (for more literature on body build indices see Pearl (16)).

The results on height and weight previously discussed make it obvious that the white school children of Hagerstown during the years 1937-1940 have necessarily increased their body weight index from year to year, whichever ratio may be chosen for the secular comparison. It holds true for almost every age class and equally for both sexes. Since there was a significant increase of mean body weight while mean stature has been constant within the limits of chance fluctuation, the mean weight per unit of stature or any function of stature must necessarily increase. Therefore, the indices must show the same secular trend as the mean weights alone. Whether this fact means an improvement of

TABLE 6

COMPARISON OF WEIGHT-HEIGHT INDICES OF QUETELET, DAVENPORT-KAUP, AND ROHRER AS OBTAINED FROM MEAN VALUES IN HAGERSTOWN, MD., 1937 TO 1940

Age in years	Quetelet* $\frac{W}{H}$	Kaup ** $\frac{W}{H^2}$	Rohrer *** $\frac{W}{H^3} \times 100$	Quetelet* $\frac{W}{H}$	Kaup ** $\frac{W}{H^2}$	Rohrer *** $\frac{W}{H^3} \times 100$
		Boys			Girls	
6-	184	1.573	1.342	180	1.543	1.325
7-	194	1.596	1.313	187	1.544	1.276
8-	205	1.615	1.272	199	1.571	1.243
9-	217	1.642	1.242	211	1.603	1.217
10-	229	1.671	1.218	228	1.665	1.216
11-	243	1.716	1.210	248	1.731	1.209
12-	261	1.777	1.209	274	1.830	1.224
13-	284	1.856	1.212	297	1.918	1.240
14-	309	1.935	1.213	313	1.989	1.262
15-	330	2.003	1.215	326	2.049	1.289
16	357	2.109	1.247	335	2.102	1.318

* $\frac{W}{H} = \frac{\text{Body weight in grams}}{\text{Body height in cms.}}$

** $\frac{W}{H^2} = \frac{\text{Body weight}}{(\text{Body height})^2}$

*** $\frac{W}{H^3} \times 100 = \frac{\text{Body weight} \times 100}{(\text{Body height})^3}$

average health or nutrition cannot be decided yet.

Apart from the secular feature, it might be reasonable to add in closing a few words on the behavior of the three different index values during the growing years. A glance at the tabulated values makes it plain that none of the three indices remains constant over the whole growth period. If this were the case, individual children of different age and height when characterized by such a weight-height index could be adequately compared to the same average value. Many investigators have attempted to find an index which would remain constant. Especially was this the intention in Kaup's laborious work (17, 18), but it did not work for the growing years of childhood. It is clearly shown by the above computations that all three average index values change from year to year of age. Both Quetelet's and Kaup's index increase in the normal course of children's growth while Rohrer's (or Livi's) index ponderalis decreases somewhat irregularly from 6 years of age through 16 years of age for the average child. (The values of Livi's index are not separately computed because the interrelationship between height and weight is absolutely the same as in Rohrer's index; compare the formulas.)

The change of the ratios, of course, is the reason that one value of the same index cannot characterize average growth; it rather demonstrates that growth of stature and body weight do not proportionately increase throughout the growing years. Therefore, growth cannot be measured by the same height-weight ratio, whichever may be chosen, at different ages, or what is in practice the same, at different body heights. This changing behavior of the weight-stature ratio within the growing years is the final reason for the construction of height-weight-age tables of growth. Certainly there is no reasonable objection to take the average values of a height-weight index of a given age and a given stature as normal values with which the individual child of the same age and stature may be compared. These normal values, of course, must change from year to year of age, and from unit to unit of stature, corresponding to the pattern of growth. Since, furthermore, in such a comparison between normal and individual index values the height and age variables are kept constant, it is still more logical and simpler to replace the height-weight ratio (whichever may be applied) by weight itself of given age and height (Baldwin (19), Martin (20), Oettinger (21)). However, the basic values for a table of "normal growth" necessitate a large number of individual measurements in each age group because each age has to be subdivided in many height classes, possibly from centimeter to centimeter.

The present Hagerstown material is not yet large enough for the construction of a representative height-weight-age table, especially not in the higher school ages. However, the new results have clearly demonstrated that average weight and also average weight per unit of stature have increased for children of the same age. Therefore, height-weight-age tables have to be reconstructed. But it seems to us better, from the public health point instead of a selection of especially healthy children alone (Baldwin-Wood-Tables) to use the records of all children present at school in the subsequent years of examination. Every selection brings in some kind of an arbitrary element not desirable in a growth table based upon the average like a life table.

SUMMARY

1. The present material reports on nearly 20,000 height measurements in school children of Hagerstown, Maryland, during four successive calendar years, 1937-1940; 10,065 measurements on boys and 9,884 on girls. While the former findings showed a consistent upward trend in body weight, mean stature of the same white school children, 6 to 16 years of age, has been fairly constant through the single calendar years of the period under observation. Therefore mean weight per unit of stature shows the same upward trend.

2. There is to be observed for the large sample a distinct sex difference in the pattern of growth. Its behavior is very much the same for height as it is for weight although the growth rates are different for both measurements. From 6 to 10 years of age, the boys are somewhat taller and heavier than the girls; at the ages 11 to 13 years, the girls exceed significantly the boys in stature and weight but immediately before the 14th year of age is completed, the female line of stature crosses again the curve of the male sex and remains below while the crossing-over for weight occurs soon after 14½ years of age.

3. Consequently there is only one minor deviation of the sex differences in the prepuberty stage of the sexes in so far as the female curve crosses the male curve somewhat earlier for stature than for weight.

This is explained by the fact that the girls at the age of 14 in the majority have already filled out the figure and outweigh the boys of the same stature. The nearly uniform behavior of the sex differences in mean height and weight makes it plain that for the growing years as a whole, and therefore for the physiology of growth, it is not so much the sex but the stature that determines the weight of a growing person, be it a boy or girl.

4. The variability of stature shows a slight upward trend with increasing age, indicating a similar dispersing effect of growth as has been found for variability of body weight. After puberty the variability of height decreases slowly, again being similar to weight. However, the variability of body weight is in every age group and in both sexes considerably greater than of stature. It is a new observation that the sex differences in the variability of height and weight exhibit a similar trend through the growing years and in particular parallel up to puberty very much the sex difference in the pattern of growth itself.

5. Three different weight-stature ratios (Quetelet, Davenport-Kaup, Rohrer-Livi) are computed. They all show a certain secular tendency to increase during the years of observation for children of the same ages since their weight has increased. But neither of them remains constant over the period of normal growth. Therefore, they cannot be used for comparing children of the same or different ages without considering their respective stature. It follows that all three variables — height, weight, age — must be correlated for a table of "normal growth" (height-weight-age tables) which are to be constructed from time to time on the basis of sufficient numbers of observations.

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THE PHYSICAL GROWTH OF ALABAMA WHITE GIRLS ATTENDING WPA PRESCHOOLS

FAIRYE C. WISE AND HOWARD V. MEREDITH[1]

Purpose

The present investigation was undertaken to ascertain information on the body size and form of white females in attendance at WPA Nursery Schools and WPA Preschools or Play Centers in Alabama.

In the past, research on the physical growth of young children has been done largely on groups representing the artisan, managerial, and professional classes. Often the samples have been drawn from private schools. The present study reports findings for children from decidedly impoverished socio-economic groups.

Again, numerous investigations have been made on the growth of children in the northeastern and northcentral states, and several are available for the western area. The present study was made in the southeast (Alabama), a region for which research on the physical growth of young children is practically non-existent.

The specific aims of this study were:

1. To obtain central tendency values at 2, 3, 4, and 5 years of age for each of fifteen body measurements on white girls attending WPA preschools in Alabama.[2]
2. To align these findings for body size with methodologically comparable findings on white girls of higher socio-economic status.
3. To present central tendency values describing the body form of Alabama WPA preschool girls and compare these with values for girls representing a higher socio-economic level.

Subjects

The subjects were 92 Alabama white girls, varying in age between 1 year 9 months and 5 years 3 months. They were enrolled at 7 WPA nursery schools and 4 WPA preschools located in small communities near Birmingham, Alabama, and at one Community Chest day nursery within the city limits of Birmingham.

Information was secured covering date of birth, place of birth of parents and grandparents, occupation of father, approximate annual income, and length of time in school. In this connection acknowledgment is made to the teachers and supervisors of the schools, the parents, and the staff of the Department of Public Welfare.

Information on birthplace of parents and grandparents was not obtainable for all cases. Place of birth of parents was available for 68 per cent of the subjects, and of grandparents for 45 per cent. Analysis of these data gave the following:

---

[1] *From the Iowa Child Welfare Research Station, University of Iowa, Iowa City, Iowa.*

[2] *In the interest of brevity, the entire group of schools studied will be referred to as WPA preschools.*

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1. All parents and grandparents were born in North America.
2. For 57 per cent of the subjects both parents were born in Alabama, while for 90 per cent both were born in the southeastern region of the United States.
3. For 39 per cent of the subjects all 4 grandparents were born in Alabama, while for 88 per cent all 4 were born in southeastern states.

Socio-economic status was appraised by analyzing information on occupation of father, annual family income and, for those employed by WPA or receiving direct relief, length of time on relief. Data on father's occupation and family income were secured for every case. The former showed 30 per cent of the fathers were recipients of direct relief or certified WPA employees, 33 per cent were employed as laborers, 19 per cent classified as skilled trade employees, and 18 per cent fell among the commercial, professional and managerial groups. Annual income ranged from $144 to $1200, with 19 per cent of the families receiving less than $500 per year and 68 per cent receiving between $500 and $1000 per year. The mean family income was $670, or about $56 per month. Of the families certified for relief or WPA employment, 50 per cent had been in these categories for upwards of two and one-half years.

It was considered tenable that children of the same cultural and economic level as those utilized, but not in attendance at a preschool or day nursery, might show differences in physical growth resulting from the absence of certain items characteristic of the school environment. Hence, the sample was described with reference to selected features, possibly differential, not ordinarily found in the home environment of children of such low status.

	Nursery Schools	Pre-schools	Day Nursery
Mid-day meal at school planned by trained dietitian	Yes	No	Yes
Cod liver oil - at least 1 teaspoonful daily except in summer	Yes	No	Yes
One-half cup fruit juice or milk daily at mid-morning or mid-afternoon	Yes	Yes	Yes
Short mid-morning rest period	Yes	Yes	Yes
Afternoon period of sleep	Yes	No	Yes

The degree to which any of these factors in the school environment influence the child's physical growth would probably be a function of the length of time the child had been in attendance at school. Twenty-five per cent of the subjects studied had been in attendance less than 6 months, 40 per cent between 6 months and 1 year, and the remaining 35 per cent between 1 and 3 years.

In summary, the subjects may be characterized as 92 normal white girls, highly homogenous for geographic region and ethnic derivation, and drawn predominantly from low socio-economic groups.

Distribution of the subjects for age yields the following:

Age (years)	Number of subjects
1.75 to 2.25	25
2.75 to 3.25	20
3.75 to 4.25	24
4.75 to 5.25	23

Obviously, the midpoints of the 4 age groups are 2, 3, 4, and 5 years respectively.

Data

The data were collected between December, 1939, and August, 1941. They consist of 92 values for each of 15 anthropometric measurements. The measurements were taken according to the technique in current use at the Iowa Child Welfare Research Station and recently described by Knott (2). All observations were made with the subject nude and in an erect position. The instrument scales were read to the nearest millimeter for 14 dimensions of the body and to the nearest pound for weight. Specifically, the measurements taken on each subject were weight; stature; sitting height; bi-iliocristal width of hips; biacromial width of shoulders; width, depth and circumference of thorax at the level of the xiphi-gladiolus junction; circumference of abdomen through the umbilicus; maximum arm girth below the insertion of the deltoid muscle; leg girth at the level of greatest cross-section in the calf region; and thickness of the skin and subcutaneous tissue over the abdomen, at the posterior of the thorax, and on the back of the arm. These measurements total 14. Analyses are presented for 15. The values for one dimension, length of lower extremities, were derived as stature minus sitting height.

Findings on Body Size

The data were subgrouped into 60 series of values - one series each for 15 dimensions at four age intervals. Table 1 gives the arithmetic mean of each series and reproduces the minimum and maximum records.

In order to more adequately portray the form of the central tendency trend for each dimension, curves were plotted using mean magnitude as ordinate and age as abscissa. Inspection of these curves, supplemented by verification from Table 1, yields the following findings:

1. Weight, stature, sitting height, length of lower extremities, shoulder width, transverse diameter of thorax, and hip width show fairly regular increments over the full period from 2 to 5 years.
2. Each of the circumferences - arm, leg, chest, and abdomen - registers a marked difference between the means at 2 and 3 years, little difference in means between 3 and 4 years, and a marked difference again between 4 and 5 years. It is probable, of course, that this tendency toward a plateau between 3 and 4 merely reflects sampling fluctuation.
3. Means for the thickness of skin and subcutaneous tissue over the abdomen and at the rear of the thorax show a decline from 2 to 4 years and a rise at 5 years. Thickness at the back of the arm is greatest at

TABLE 1

BODY SIZE: Means, together with minimum and maximum values, for 15 anthropometric measurements at each of four ages. Subjects: Alabama white girls in attendance at WPA Preschools 1939-1941.

Midpoint of Age Groups (yrs.):	Two		Three		Four		Five	
Number of Cases:	25		20		24		23	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Stature (cm.):	85.1	78.6-90.4	92.4	84.2-99.0	99.9	92.2-109.7	105.6	94.0-115.9
Sitting Height:	51.3	48.0-55.5	53.9	50.4-57.0	57.4	52.4-61.4	59.6	53.8-64.3
Lower Limb Length:	33.8	29.4-40.4	38.5	33.8-42.3	42.5	38.4-49.1	45.9	40.2-52.9
Shoulder Width:	19.7	17.3-21.3	21.3	19.4-22.7	22.2	20.4-24.4	23.4	20.8-25.8
Hip Width:	14.5	13.3-15.5	15.8	14.6-16.9	16.4	14.9-18.1	17.2	15.6-19.1
Chest Girth:	49.2	45.3-52.6	51.0	48.2-53.7	51.6	47.4-55.7	53.4	49.4-57.8
Abdomen Girth:	49.7	46.0-51.8	51.2	47.3-53.9	51.6	46.7-55.3	53.0	47.8-58.6
Chest Width:	16.9	15.6-18.3	17.6	16.8-18.9	18.0	16.5-19.2	18.7	16.8-20.1
Chest Depth:	12.9	11.0-14.1	13.1	11.8-13.9	13.3	11.9-14.4	13.8	12.4-15.5
Arm Girth:	15.4	13.3-16.9	16.2	14.3-17.8	16.1	14.2-18.5	16.6	14.3-18.5
Leg Girth:	19.6	17.1-22.2	20.8	18.5-22.5	21.0	18.5-23.1	21.6	19.0-24.0
Weight (kg.):	12.3	9.3-15.0	14.3	12.3-15.9	15.7	13.2-18.1	17.7	13.6-23.1
Thickness of skin and sub-cutaneous tissue (mm.):								
Over abdomen:	5.0	3.0-7.5	4.9	4.0-7.0	4.5	2.5-6.5	5.3	3.5-7.5
At arm back	7.0	5.0-9.0	7.4	5.5-9.0	6.9	5.0-10.0	7.1	5.0-9.0
At chest back	4.4	2.5-6.5	4.1	3.0-5.5	3.6	2.5-5.5	4.1	2.5-6.5

3 years, least at 4 years and similar at 2 and 5 years. It is interesting that the lowest mean for all three determinations of tissue thickness is at 4 years -- the age of relatively low means for the girth measurements.

One of the aims of the study was to compare the body dimensions of Alabama WPA preschool children with anthropometrically identical data on white girls of higher socio-economic status. For this purpose records were available on two independent groups of American-born white girls of North European ancestry in attendance at the University of Iowa Preschool Laboratories during the years 1938 through 1941. One group consisted of 34 children between the ages of 2 years 9 months and 3 years 3 months, the other of 50 children between 4 years 9 months and 5 years 3 months. Of these 84 Iowa City girls, approximately one-third represented the managerial or commercial groups and two-thirds the professional classes.

The known similarities and differences between the Alabama and Iowa samples may be epitomized as follows: Both are rigorously comparable for anthropometric technique, age-group limits, and statistical procedure; the time during which the data of each were collected is practically identical; the sex is the same for both; the ethnic derivations are similar -- although allowance should be made for a possible slight difference due to what might be termed the tendency of subgroups within the broad designation of North European ancestry toward lineal homogeneity; the geographic locations differ -- however, research to date would credit little, if any, of a differential finding between Alabama and Iowa to "climatological and meterological effect" (4); and, finally, there is the unequivocal difference in socio-economic status -- the Iowa sample representing a superior cultural level obtained through a private preschool, and the Alabama sample a low income group drawn from WPA preschools.

Table 2 presents the means for each sample at 3 and 5 years, together with results from an analysis of the differences at each age. It is found:

1. With the exceptions of girths of thorax and abdomen at 3 years and depth of thorax at 3 and 5 years, all means are smaller for the Alabama groups than for the Iowa groups. Compared with means from the literature for children of high socio-economic status, the Alabama means are lower by a minimum of (a) 3.0 cm. for stature and 0.4 kg. for weight in studies by Gray and Ayres (1), Simmons and Todd (7), and Wallis (8) and (b) 1.0 cm. in biacromial diameter and 0.3 cm. in bi-iliocristal diameter for the studies by Gray and Ayres and by Wallis.

2. The differences between corresponding means are greater at 5 years than at 3 years for all measurements other than the thoracic dimensions and the composite measure of thickness of skin and subcutaneous tissue. This tendency toward divergence with increasing age is also obtained from alignment of the Alabama means with other means representing the higher socio-economic groups. On the average, the studies of Gray and Ayres, Simmons and Todd, and Wallis yield means for stature higher by 3.5 cm. at 3 years and 4.8 cm. at 5 years and, for weight, higher by 0.5 kg. at 3 years and 1.5 kg. at 5 years.

3. At 3 years of age, differences statistically significant at the one per cent level of confidence (t values greater than 2.6) are obtained

TABLE 2

BODY SIZE: Means, differences between means, and t values for 13 measures on Alabama WPA preschool girls and girls at University of Iowa Preschool Laboratories.

	Three Years				Five Years			
	Alabama mean	Iowa mean	Alabama mean minus Iowa mean	t	Alabama mean	Iowa mean	Alabama mean minus Iowa mean	t
Stature (cm.):	92.41	95.74	-3.33	3.3	105.56	110.52	-4.96	4.1
Sitting Height:	53.93	55.94	-2.01	3.2	59.61	61.96	-2.35	4.0
Lower Limb Length:	38.48	39.80	-1.32	2.4	45.94	48.56	-2.62	3.7
Shoulder Width:	21.34	21.87	-0.53	2.0	23.41	24.59	-1.18	4.2
Hip Width:	15.80	16.10	-0.30	1.6	17.24	17.86	-0.62	2.5
Chest Girth:	51.02	50.43	+0.59	1.3	53.38	53.64	-0.26	0.4
Abdomen Girth:	51.22	50.92	+0.30	0.5	53.02	54.31	-1.29	1.5
Chest Width:	17.64	17.83	-0.19		18.68	18.80	-0.12	
Chest Depth:	13.10	12.94	+0.16		13.77	13.69	+0.08	
Arm Girth:	16.22	16.62	-0.40	1.3	16.60	17.49	-0.89	2.7
Leg Girth:	20.79	21.15	-0.36	1.2	21.61	23.47	-1.86	4.9
Weight (kg.):	14.27	14.67	-0.40	1.1	17.66	19.40	-1.74	2.8
Sum of three measurements of thickness of skin and subcutaneous tissue (mm.):	16.35	17.52	-1.17	1.4	16.52	16.99	-0.47	0.5
Number of cases:	20	34			23	50		

For fifty degrees of freedom, t must exceed 2.6 to indicate statistical significance at the one per cent level of confidence, and be not less than 2.0 for significance at the five per cent confidence level.

for stature and sitting height. At 5 years, statistically significant differences are indicated for stature, sitting height, length of lower extremities, shoulder width, arm girth, leg girth, and weight.

Findings on Body Form

As media in describing selected characteristics of the body form of WPA preschool children, the following indices were calculated:

1. The Skelic Index -- length of lower extremities (derived as stature minus sitting height) in percentage of sitting height.
2. The Thorax/Abdomen Index -- thoracic circumference at the level of the xiphi-gladiolus junction in percentage of girth of the abdomen at the level of the umbilicus.
3. The Hip/Stem Index -- bi-iliocristal diameter in percentage of sitting height.
4. The Thoracic Index -- transverse diameter of the thorax in percentage of antero-posterior diameter.

All of the components of these indices were available on every subject. Consequently, 92 values for each index were computed, distributed, and reduced. The results are given in Table 3.

TABLE 3

BODY FORM: Means, together with minimum and maximum values, for four anthropometric indices at each of four ages. Subjects: Alabama white girls in attendance at WPA preschools 1939-1941.

Midpoint of Age Group (yrs.):	Two	Three	Four	Five
Number of Cases:	25	20	24	23
Skelic Index:				
Mean	66.0	71.5	74.2	77.0
Range	55-84	66-77	69-81	70-84
Thorax/Abdomen Index:				
Mean	99.0	99.7	100.1	100,9
Range	94-105	96-106	96-106	94-108
Hip/Stem Index:				
Mean	28,3	29.3	28.6	28.9
Range	25-30	28-33	27-31	27-31
Thoracic Index:				
Mean	131.2	135.1	136.4	135.8
Range	120-147	128-150	128-151	125-152

Inspection of this table shows:

1. There is a steady increase in the mean skelic index from 66 at 2 years to 77 at 5 years. At age 3, individual cases give ratios of lower limb length to stem length as low as the mean for 2 years and as high as that for 5 years.
2. Relative to circumference of abdomen, circumference of thorax increases from 99 per cent at 2 years to 101 per cent at 5 years. In other words, mean abdomen girth exceeds mean chest girth at 2 years, the two girths are practically equal at 3 and 4 years, and the former is exceeded by the latter at 5 years. The zone of individual differences is

almost the same at all four ages.

3. Changes in the mean hip/stem index from age to age are neither large in amount nor consistent in direction. On the whole, bi-iliocristal width of hips appears best interpreted as fluctuating around 28.8 per cent of sitting height throughout the age period studied. Individual girls have ratios between 25 per cent and 33 per cent.

4. There is a marked increase in mean thoracic index between 2 and 3 years, a moderate increase between 3 and 4 years, and a slight decrease from 4 to 5 years. In general, breadth of thorax is found to approximate 131 per cent of thoracic depth at 2 years and 136 per cent at 5 years. Records for individual girls vary from widths less than 1¼ times depth (at 2 years) to widths upwards of 1½ times depth at 4 and 5 years.

As for body size, at ages 3 and 5 years it is possible to compare these body proportions of Alabama girls from WPA Preschools with corresponding figures for Iowa City girls typifying a moderately high socio-economic level. It is found:

1. For the Iowa City series already described, the mean skelic indices are 71.2 at 3 years (N=34) and 78.4 at 5 years (N=50). These values are reinforced by means of 71.2 (N=90) and 78.2 (N=195) respectively, reported (5) from an analysis of data collected 1929-36 on a similar sample of Iowa City girls. In conjunction with analogous means from Table 3, it follows that length of lower limbs relative to sitting height is practically the same for the Alabama and Iowa City groups at three years and, at 5 years, over one per cent less for the former than for the latter.

2. The means of the ratios of chest circumference to abdomen circumference, on the Iowa City data accumulated 1938-41, are 99.2 at 3 years (N=34) and 98.9 at 5 years (N=50). The negligible difference between these means contrasts with a difference of more than one per cent shown in Table 3 for the Alabama girls at 3 and 5 years. At 3 years the two socio-economic groups do not differ appreciably, while at 5 years chest girth tends to exceed abdomen girth in the impoverished group (mean index about 101) and to be less than abdomen girth in the privileged group (mean index approximately 99).

3. On the Iowa City data gathered 1938-41, means for bi-iliocristal diameter in percentage of sitting height are 28.8 at 3 and at 5 years. On comparable Iowa City data collected 1929-36 (3), the means for this index are 29.2 at 3 years (N=66) and 29.4 at 5 years (N=94). The Alabama means, as shown from Table 3, approximate the 1929-36 mean at 3 years and the 1938-41 mean at 5 years. Since the difference in results from the two Iowa City groups is seemingly a product of chance fluctuation in random sampling, the differences between means for the Iowa City and Alabama groups are considered lacking in morphologic significance.

4. The thoracic index means from the Iowa City materials, for 1938-41, are 137.9 at 3 years and 137.4 at 5 years, for 1929-36 (6), 130.7 at 3 years (N=71) and 136.4 at 5 years (N=109). The Alabama means are between these means at 3 years and below them at 5 years. Weisman (9) compared central tendency values for the thoracic index on school children from the best and poorest sections of Minneapolis. He found the typical child of the higher socio-economic classes to have a chest

slightly flatter relative to its breadth than the typical child of the lower classes. At 5 years of age --though not at 3 years-- the contour of the chest for our Alabama children of low status likewise registers a slight tendency to be deeper relative to width than the Iowa City children of markedly higher status.

Summary

The general purpose of this study was to describe the body size and form of a group of Alabama white girls in attendance at WPA Nursery Schools and Preschools during 1939-41. The specific objectives were, first, to make analyses for 15 measurements of size and four indices of form and, secondly, to align the results with rigorously comparable findings on Iowa white girls of decidedly higher socio-economic status.

The subjects were 92 Alabama white girls ranging in age from one year nine months to five years three months. They represented a definitely low socio-economic level. The series of anthropometric data taken on each girl consisted of stature; sitting height; length of lower extremities; bi-iliocristal and biacromial diameters; width, depth, and circumference of thorax; girth of abdomen, arm, and leg; weight; thickness of skin and subcutaneous tissue over the abdomen and at the posterior of the arm and the thorax.

For each of the 15 measurements, and for 4 anthropometric ratios, the data were distributed into 4 age groups with midpoints at successive years from 2 to 5. Tabular and graphic analyses gave the following findings for central tendency:

1. A steady increase from 2 to 5 years for weight, stature, sitting height, length of lower limbs, shoulder width, width of thorax, and hip width.
2. A fairly rapid increase except between 3 and 4 years for the 4 measurements of circumference. (The tendency toward a plateau between 3 and 4 may register nothing more than sampling fluctuation.)
3. A decline from 2 to 4 years and a rise at 5 years for thickness of skin and subcutaneous tissue over the abdomen and at the rear of the thorax. For each of the measures of tissue thickness, the lowest mean was at 4 years -- the age of smallest increase in the girth means.
4. A marked increase in the skelic and thoracic indices between 2 and 3 years. Length of lower extremities in percentage of sitting height showed a moderate rise from 3 to 5 years. Thoracic width in percentage of depth of thorax registered a moderate rise between 3 and 4 years and a slight decline from 4 to 5 years.
5. A small but steady increase from 2 to 5 years for chest circumference in percentage of girth of abdomen. No change in the hip width/sitting height index of appreciable magnitude or consistent direction.

At 3 and 5 years of age, the data on Alabama WPA preschool children were aligned with methodologically identical data on Iowa City children of markedly higher socio-economic status. The following comparative statements accrued:

1. With few exceptions, the means for body size on the Iowa groups exceeded those for the Alabama groups. The excess was upwards of three

centimeters in the case of stature.

2. The differences between the Iowa and Alabama samples tended to be larger at 5 years than at 3 years. Statistically significant differences at 5 years were obtained for stature, sitting height, length of lower limbs, shoulder width, arm girth, leg girth, and weight.

3. At 3 years, the two socio-economic groups did not differ appreciably in those aspects of body form subjected to study. At 5 years, compared with the Iowa sample, the Alabama sample gave a slightly smaller abdomen girth relative to chest girth, slightly shorter lower limbs relative to body stem, and a slightly deeper thorax relative to thoracic width.

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LANGUAGE DEVELOPMENT OF CHILDREN IN TWO DIFFERENT RURAL ENVIRONMENTS[1]

G. M. WORBOIS

Different environments may not provide equally stimulating conditions for the development of language ability of children. Two common environments in rural areas are those of the consolidated and the one-room school. The present study was designed to determine if consolidated school children develop more rapidly in certain language abilities than do the children of the same IQ and the same initial ability in one-room schools.

It is possible that the organization and administrative practices of some one-room schools provide the child with less opportunity for a functional use of language than do the conditions of other school environments. It is possible that the teachers, confronted with pupils of widely different ages, and several relatively well-defined groups, all of which vary in needs, are handicapped in providing adequate stimulation for language use. There may, in addition, be attitudes in some one-room schools which do not encourage verbalization of real and vivid experiences of the child.

Some indication of the development of language ability by consolidated and one-room school children is given in the study by Baldwin, Fillmore, and Hadley (1). They divided the items of the Stanford-Binet intelligence test into language and non-language items arbitrarily, and determined the total months credit for each. These totals were compared with expected months credit if the language and non-language items were passed equally frequently, and the chi-square test was applied. This test showed that the hypothesis of "no difference" may be rejected in both the case of the one-room school children and the consolidated school children at a high degree of confidence. In other words, it is relatively certain that these rural children failed a higher percentage of the language items than the non-language items. They found that the greatest deficiency was in the use of language in "a creative way." (p. 246f.)

Methods and Procedures

A rural area was selected in which was located a consolidated school surrounded by several one-room schools. Enough of the neighboring one-room schools were selected on the basis of proximity to the consolidated school so that there would be about an equal number of children at each age or grade level in the two groups. All the children were living within a small farming area (about 10 mile radius) of rich soil and favorable farming conditions. It was proposed to measure by repeated tests the development of these children over a relatively long interval. The technique used was the analysis of covariance, holding initial IQ and initial score constant, and evaluating differences on the final measure.

[1] *This study, from the Iowa Child Welfare Research Station, was directed by Dr. Ralph H. Ojemann.*

Stanford-Binet Vocabulary Test

The vocabulary item of Form L of the Stanford-Binet intelligence test was given to three groups: Group A, pupils having their first year of school attendance during either of the two years of the study; Group B, pupils having their first two years of school attendance; and Group C, pupils having their second and third years of attendance during the two years of the study. Tests were taken in the fall and the spring. Only those pupils were studied who had been in no other school environment, and who continued in the school for both measures.

Iowa Every-Pupil Tests

The Vocabulary and Language Skills sub-tests of the Iowa Every-Pupil Tests were given to the third and fourth grade pupils of the consolidated and one-room schools near the end of the first semester. A year later another form of the same test was given to the pupils who had taken the previous test and who were still in the school.

"Verbal Effectiveness Test"

An experimental situation was designed to test how effectively children could verbalize an experience. The prerequisites set down for the procedure were: 1) that it should contain only material and manipulations familiar to all the children, 2) that to verbalize the experience should require vocabulary and sentence structure well within the child's ability, and 3) that the expression of the child should be in such a form that its effectiveness could be evaluated objectively.

The situation designed required the child to string a set of beads varying in color, size, and shape. Six strings of beads were constructed consisting of the same colors, shapes, and sizes, but varying in combinations, each containing eight beads. These six sets of beads were shown to the subject, and he was given a box of beads and a string. The instructions were as follows:

> "Here are six strings of beads. I want you to make another string with these beads (pointing) just like one of these. It doesn't make any difference which one you make. You can make any one you want to. I am not going to see which one you make. You will have to tell me just which beads you put on so that I can make another one just like yours. Notice that the beads are different colors, different shapes, and different sizes." Ask S the name of each of the colors (yellow, red, pink, green, blue, and purple) on String No. 4. Ask, "Is this a big one or a small one?" for each of the different beads on String No. 1. Say, "Now look at this string (No. 6). Is this bead (pointing) long, flat, or round?" Say the same for the second bead. For the third and the other beads of this string say, "What shape is this one?" Hold up large, purple, round bead and say, "Now tell me what bead this is." If S omits size, shape, or color, say, "And what _____ is it?" Prompt S if no response or incorrect. Do the same for large, red, flat bead. Say, "Now make a string of beads like any one of those and let me know when you have finished." After S has finished say,"Now tell me what beads you put on your string

so I can put the same ones on mine. Remember the beads are different colors, different shapes, and different sizes."

After the experimenter was sure that the child understood the task and had told the child to make his string of beads, a screen was placed between the child and the experimenter on the table. When the child had said that he had made his set of beads and the experimenter had asked him to tell which beads he had put on the string, the recorder was started by means of a silent switch. The microphone was concealed, and the subject did not know that his speech was being recorded.

After the child had finished telling which beads he had strung, a picture was given to him with the request, "Look at this picture and tell me all about it." This picture was the "Dutch Home" in Form L, of the Stanford-Binet scale which appears at the III-6 year level. He was allowed 60 seconds to tell about this picture, during which time his speech was recorded.

The subjects for this experimental situation were selected from Group B, described above, and were matched on the basis of chronological age, IQ, and sex. The children had each had about a year and a half of school attendance and had previously had three individual intelligence examinations in the same testing conditions. Eight pairs resulted from this matching.

The score for verbalizing about stringing the beads was simply the number of beads correctly identified in the two groups. The score for verbalizing about the picture was the total number of words, and the number of different words used.

Results

"Verbal Effectiveness Test"

The children (8) in the consolidated school identified fully (i.e. gave size, shape, and color) a total of seventeen beads. Those in the one-room schools (8) identified fully only five beads. The difference is significant at the one per cent level of confidence according to the chi-square test ($\chi^2 = 6.6$). All of the subjects in the consolidated school group gave the color for all of the beads (64), whereas in the one-room school group the color was given for only 56 beads. This difference was significant at the one per cent level of confidence ($\chi^2 =$ 7.7). The shape was given correctly for 38 of the beads by those in the consolidated school and for only 21 of the beads by those in the one-room schools. This difference is also significant at the one per cent level ($\chi^2 = 8.0$). In giving the size, only a small number in the case of both the consolidated and the one-room school group succeeded.

In response to the picture, the children in the consolidated school gave a mean of 72.8 words and those in the one-room schools gave a mean of 38.2 words. This difference is significant at the five per cent level of confidence according to the t-test of Fisher ($t = 2.7$). The children in the consolidated school used a mean of 31.4 different words and those in the one-room schools used a mean of 23.0 different words. This difference just misses being significant at the five per cent level ($t = 2.2$). The vocabulary, of course, in this kind of situation is largely confined to the objects of the picture.

Stanford-Binet Vocabulary

The children in the consolidated school (Group A) defined an average of 7.5 words of the Stanford-Binet vocabulary item at the end of their first year of school attendance. Those of the one-room schools defined an average of 5.7 words. The consolidated school children gained during the school year 1.2 words, or the equivalent of nearly a full year according to the norms of the test. Those in the one-room schools gained only 0.3 words. Holding the initial score and IQ constant by analysis of covariance, the difference at the end of the first year's attendance was significant at the one per cent level of confidence, as indicated by an F-value of 18.3 in Table 1. The children in the consolidated school were higher in initial vocabulary score than were those in the one-room schools, and the difference was significant at the five per cent level. They were also older by about five months. When difference in age was held constant, however, by analysis of covariance, differences in initial vocabulary scores were not significant.

TABLE 1

STANFORD-BINET VOCABULARY CHANGE FOR CHILDREN IN CONSOLIDATED AND ONE-ROOM SCHOOLS

	Consolidated			One-Room				F_t	
	N	M	σ	N	M	σ	F_0	(1%)	(5%)
Group A	34	7.5	1.50	30	5.7	1.72	18.3	7.1	4.0
Group B	16	8.3	1.26	14	6.5	1.80	6.8	7.7	4.2
Group C	13	8.7	1.26	11	7.4	1.49	4.7	8.1	4.4
Mean Initial IQ									
Group A		106			105				
Group B		105			104				
Group C		112			104				
Mean Initial Score									
Group A		6.3			5.4		5.6	7.1	4.0
Group B		6.1			5.5		1.3	7.7	4.2
Group C		7.6			7.1		xx	xx	xx

During the first two years of school attendance the subjects in Group B in the consolidated school gained an average of 2.2 words, while those in the one-room school gained an average of 1.0 words. The difference in final means, holding initial score and IQ constant, is significant between the one and five per cent levels of confidence. During their second and third years of school attendance the children in Group C in the consolidated school gained an average of 1.1 words while those in the one-room school gained an average of 0.3 words. This difference, holding initial score and IQ constant, is significant at the five per cent level of confidence.

Iowa Every-Pupil Tests

At the end of the first semester of the third and fourth grades the children in the consolidated school secured a mean score on the Vocabulary test of 45.7. A year later they secured a mean score of 58.6, or a gain of 12.9. This is equivalent to about a year and three months of academic achievement. On the other hand, those in the one-room schools gained an average of 7.2 months. As indicated in Table 2, the difference between the consolidated school children and the one-room school children after one year's attendance is statistically significant at the one per cent level, holding initial score and IQ constant by analysis of covariance.

TABLE 2

CHANGES IN IOWA EVERY-PUPIL VOCABULARY AND LANGUAGE SKILLS TEST SCORES FOR CHILDREN IN THIRD AND FOURTH GRADES OF CONSOLIDATED AND ONE-ROOM SCHOOLS

	Consolidated	One-Room	Diff.	F_o	F_t(1%)	F_t(5%)
Vocabulary						
N	25	30				
M	58.6	44.8	13.8	7.4	7.2	4.0
σ	12.8	12.5				
Language Skills						
N	26	34				
M	59.9	44.0	15.9	4.6	7.1	4.0
σ	13.3	12.2				
Vocabulary						
Mean Initial IQ	110	100				
Mean Initial Score	45.7	37.6				
Language Skills						
Mean Initial IQ	111	100				
Mean Initial Score	48.0	34.8				

On the Iowa Every-Pupil Language Skills test the consolidated school children gained 11.9 months during the year of school attendance, while those in the one-room schools gained only 9.2 months, as indicated in Table 2. The difference after a year of attendance, holding initial score and IQ constant by analysis of covariance, is statistically significant at the five per cent level of confidence.

Summary and Discussion

The results of these three tests agree in showing higher scores for the consolidated school children. Furthermore, it appears that differences between the consolidated school children and the one-room school children are associated with attendance in these school environments.

Attempt was made by means of a short-time-sampling technique to find out if the activities of the teacher and of the pupils differed in important respects in these two school environments. Twenty-one three-minute samples of pupil and teacher activity taken simultaneously by two observers was found to give a per cent of agreement of 91. The results of these observations show that teachers in the one-room schools ask for and accept more often memorized, formal answers. This occurred in 59 per cent of the three-minute samples of teacher activity in the one-room schools, and in only 40 per cent of the samples of teacher activity in the consolidated school. This difference was significant at the three per cent level of confidence ($\chi^2 = 4.95$). The pupils in the consolidated school read or otherwise used references (not immediate text) significantly more than those in the one-room school.

These differences in schoolroom activities are possibly of significance for the language development of children living in these two types of school environment. Possibly also of significance is the fact that the teachers in the one-room schools have had only an average of 0.6 years' education beyond high school, while those of the consolidated school have had an average of 3.0 years beyond high school ($t = 4.5$). On the other hand, the home environment of the children in the one-room schools appears to be similar to that of the children in the consolidated school, as judged from mid-parent education and occupational level. Measures of parents' attitudes toward the child and the school also showed the two groups to be similar.

The data of this study indicate that significant differences in the growth of language abilities appeared in the two rural environments considered in this investigation. They point to the importance of designing environments that provide for an enriched language development of rural children.

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THE EFFECT OF A LEARNING PROGRAM DESIGNED TO ASSIST YOUTH IN AN UNDERSTANDING OF BEHAVIOR AND ITS DEVELOPMENT

MILDRED I. MORGAN AND RALPH H. OJEMANN[1]

General observation as well as clinical analysis of youth problems tends to indicate that many problems arise from an inability to interpret the behavior of others. A young man or woman may resent a dominating father or mother. If the young person does not understand, for example, that one of the motives of domination by the parent may be insecurity on the part of the parent there is a tendency to consider the parent as an "opponent" rather than as one who is in need of help. Similarly, when a boy does not take a girl on a date there is a tendency for the girl to assume that there is something "wrong" with her instead of considering the many possibilities - the young man may feel inferior because he does not have enough money or he may feel that the girl is more experienced in social relations than himself and therefore he does not wish to expose his lack of knowledge.

It would seem helpful in making adjustments to have an understanding of human behavior as it occurs in family and social relationships including especially a knowledge of the many explanations that may underlie a given form of behavior, how various behavior patterns develop and how one can meet a situation when only an approximate indication of the real motive is available.

In this study a program was designed to develop an understanding of behavior as it occurs in marriage, family, social and selected economic relationships. This program was administered to two groups of subjects, one a group of young people in school and the other a group of out-of-school employed youth.

The general plan of the study consisted in selecting equated experimental and control groups; obtaining measures of selected attitudes and conflicts at the beginning of the experiment; administering the learning program to the experimental group and obtaining final measures. The duration of the experimental period from initial to final tests was approximately four months.

One of the experimental groups of the study consisted of 28 college students, 16 women and 12 men; the other, of 28 out-of-school youth, 15 women and 10 men. The same type of membership was represented in the corresponding control groups. The out-of-school employed subjects were recruited by staff members of Young Men and Young Women Christian Associations assisted by young people from their membership. The program was presented as an opportunity to discuss under leadership problems involved in family, marriage and economic adjustments.

Membership was entirely voluntary. This fact must be taken into account in describing the experimental groups. They represented groups already high in interest and in the realization of the importance of the problems to be considered. In the employed group a wide range of types of positions held was represented. A variety of social experience as to dating, engagements, et cetera, was represented in both the employed group and student group. The mean age for the student group was 20.4 years while that for the employed group was 21.0 years. For the employed group the mean educational level was slightly beyond four years of high school; the mean for the student group fell at the third year of college.

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The comparisons of the experimental and control groups were made in the following areas: personality conflicts as measured by the Luria procedure and selected attitudes as measured by methods devised for this study.

The details of the Luria procedure including evidence as to its validity have been described elsewhere (1). In administering the Luria test the central processes were brought into play using a list of 100 words ordinarily associated with the four areas: home, companions of both sexes, school or work and general outlook on life. Conditions and directions for administering the tests were carefully worked out and applied. Measures were obtained of voluntary movements, involuntary movements, reaction time and verbal responses. The measures used in this study are the disturbances in voluntary movements and the proportion of verbal responses classified as indirect, egocentric and omitted.

The measurements of attitude were obtained as follows. Each subject in the experimental and control groups was asked to write answers to certain questions concerning himself. The questions on this report blank were designed to reveal rather indirectly the subject's attitude toward his home and family, his social relationships, his work, and toward what he felt was worth working and striving for in life. The questions were designed to approach each attitude from several angles. An informal interview was then held with each subject for two purposes: to obtain further information on the attitudes of the subject which would clarify anything not definite on the self-report blank and to establish rapport on the part of the subject and experimenter in preparation for the teaching program.

Data obtained from initial interviews and from the self-report blanks were translated into scale values on a seven-point scale. Data on the following attitudes were obtained:

1. Attitude toward parents.

   As illustrative of the extremes of this attitude a young person would be rated "1" if he seldom disagreed with his parents and turned to them with practically all of his decisions. He would be rated "7" if he rejected his parents giving them practically no credit for what he has become.
2. Rating as to social status with the opposite sex.

   The subject would be rated "1" if he stated that he doesn't rate at all with the opposite sex and feels this lack keenly and "7" if very popular, conscious of it and reveling in the fact.
3. Attitude toward place of sex in life.

   A rating "1" was given a person who feels sex to be base and seeks not to recognize that it has any place in life. At the opposite extreme is the young person who considers sex and its physical expression to be preeminent.

4. Attitude toward self-determined goals and standards.

   A rating of "1" implies uncritical or blind acceptance of institutional goals, of family, church or economic level; the other extreme "7" is one who rejects institutional goals.

5. Attitude toward social problems.

   The individual rating "1" reveals relatively little sympathetic interest in social problems or conditions. Self-interest seems paramount. A rating of "7" given to those subjects who were much concerned with social problems.

Reliability of Measuring Instruments

Reliability of Luria Scores

Using a split-half method without Spearman-Brown correction the following correlations on the initial tests between halves were obtained.

Measure	N	Original Correlations
	Student	
Voluntary disturbances	62	.82
Verbal scores	62	.85
	Employed Group	
Voluntary disturbances	58	.86
Verbal scores	58	.73

Reliability of Classifications of Verbal Responses

In previous investigations it was found that the classification of verbal responses as suggested by Jung is too detailed to obtain satisfactory reliability. While adhering to the major principles of Jung's scheme the major categories were simplified much as in the study by Ojemann and Grant (3). The definitions of the categories were carefully refined. Five hundred verbal responses were analyzed by two observers yielding a percentage of agreement of .88.

Reliability of Rating Scale for Attitudes

As indicated above data from the self-report blanks and initial interviews were translated into scale values on a seven-point scale. Data from 5 subjects selected at random were rated before and after the learning program on each of the 5 attitudes by 3 observers. The following table indicates reasonably satisfactory reliability.

Raters	Ratings before learning program	Ratings after learning program
A vs B	21 of the 25 possible ratings were in exact agreement or one step apart	23 of the 25 ratings were in exact agreement or one step apart
A vs C	19 of the 25 ratings in exact agreement or one step apart	22 of the 25 in exact agreement or one step apart

Validity of Luria Test

In connection with this study an analysis of the validity of the Luria procedure was made. This has been reported in a separate publication (1).

Description of Learning Program

The learning program consisted of an initial interview, eight group meetings taught by group discussion or seminar method, one joint meeting of the two experimental groups, together with assigned selected readings and an individual teaching conference. Examples of titles for the discussion meetings include:

Learning to live with one's family as an
independent adult
Dating and courtship
Choice of mate and engagement
Marriage adjustments
Attitude toward work and money
Goals and standards

In designing the learning program it was recognized that much of the popular material in this field consists of platitudes and generalities, often without careful recognition of the limits of knowledge and the needs of the learner. From a careful analysis of basic data and problems as to the nature of the learner and the material to be learned, criteria for selecting learning experiences were devised and applied. Included in this list was the following:

> Changes in knowledge produced in the course of the learning program must be in accord with the available scientific evidence. An important part of each generalization is its probable error which clarifies the limits of our knowledge.

From the initial interviews some knowledge of the problems of the subjects was secured and as the program developed more indications were obtained. It was against this background of growing knowledge of the problems of the groups that the learning program was built.

For example, the chief concerns of the group relative to the parental family were whether or not the parent understood the necessity for self-direction on the part of the young person and allowed him increasingly to make his own decisions. If employed, there appeared the additional problem of dependent parents thus delaying marriage for youth. In this group, too, were those whose fathers were unemployed, and who because of unemployment had lost self-confidence, thus further complicating the family relationships. Some parents of the employed group, although not dependent, were very dictatorial regarding the child's earnings. This tended to produce frustration on the part of both parents and child.

All subjects showed some frustration regarding the lack of opportunity to meet members of the opposite sex; the high commercialization of recreation; and their own lack of originality and courage in creating interesting things to do rather than following the accepted sophisticated social pattern of their respective communities.

Sex antagonism, showing resentment against attitudes and practices of the other sex, was expressed again and again in the course of the meetings. As each attitude emerged in the study group, the experimenter sought to integrate it into the learning process. Sometimes it was dealt with immediately; at other times it would be brought into the discussion at the following meeting when the group could be more objective about it, or the experimenter could bring to the group research material or illustrations which would help the group to see why such behavior occurs, or why certain points of view are held with such vehemence.

Again, not much time was spent on the discussion of money as a subject in itself, but it came up for discussion very often as a symbol of value or of power in family relationships or in the social relationships of men and women as well as in the total culture pattern of American living.

This was also true of a person's standards, scheme of values, or goals for living. The leader did not plan for an abstract discussion of standards and values but again and again in the discussion of specific problems such measuring rods as, "What would prove to be lastingly satisfying?" or "Does this matter consider only the self-interest of the individual or does it take into account the well-being of others?" were applied.

Very little consciousness of social and economic problems was found in either the employed or student group. Each subject was deeply concerned over his individual lack of economic security or vocational future, but the group as a whole seemed quite unaware of their individual problem being a part of the whole. There were individual exceptions of subjects who were deeply concerned over the whole social situation, but again, they were so far in advance of the thinking of most of the group that their contribution was not all it might have been.

The women, as a group, were even more unaware of social and economic problems than were the men. For the majority of them, marriage was their goal in life and along with marriage, a naive expectancy of economic security. Again, there were individual exceptions to this point of view.

A further indication of the nature of the learning program may be obtained by examining the goals which leader and group used as guides in their discussions. The goals were stated in terms of changes to be produced in the learner. In the discussion on The Family and Our Growth to Independent Adulthood for example, the goals were as follows:

a. To assist the group in the location of areas of tension most frequently found in family relationships of youth eighteen to twenty-five years of age.
b. To develop an understanding of the manifold possible causes underlying these tensions on the part of both youth and their parents.
c. To help youth to become aware of some of the possible effects on personality development of a long period of economic dependency such as is true for some students as well as the possible effects created by having to

assume financial responsibility for dependent parents at an early age necessary for some employed young persons.

d. To create a more favorable attitude toward seeking to understand causes of parental behavior rather than resorting to blame or conflict.

A detailed description of the learning program together with detailed records of class discussions, et cetera may be found in Morgan (2).

Quantitative Results

In analyzing the results of the initial and final test scores, the significance of the differences between means was tested by using "t" for the means of related measures. Each subject in the experimental group was paired with a subject in the control group using sex, the initial measure of the voluntary disturbances, and the verbal responses as the equating measures. The difference between the two means in the end test was then obtained and "t" of the difference used as a measure of significance.

The employed experimental and control groups were well matched on the initial test (Table 1) as indicated by a value of "t" for differences between means of voluntary disturbance scores equal to .51 and verbal scores equal to .57.

On the final test the difference between the employed experimental and control groups is significant well beyond the 1 per cent level (Table 1). It is to be noted that the differences are consistently high for both the voluntary disturbance scores ("t" 4.20) and the verbal scores ("t", 4.01). The value of "t" at the 1 per cent level of significance is 2.797.

TABLE 1

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL TESTS BETWEEN EXPERIMENTAL AND CONTROL GROUPS (EMPLOYED GROUP)

Measures	N	Means of Differences	Σd^2	"t"	"t" for 1% Level of Significance
			Initial Test		
Voluntary disturbances	25	.60	835	.51	2.797
Verbal scores	25	.72	954	.57	2.797
			Final Test		
Voluntary disturbances	25	23.16	18293	4.20	2.797
Verbal scores	25	15.48	8958	4.01	2.797

The analysis of the data from the student experimental and control groups shows that these groups, too, were evenly matched on initial test scores (Table 2) for both measures. For voluntary disturbances, the value of "t" is .12 while for verbal category measures, the value is .20.

In the final test (Table 2), "t" for significance of difference between voluntary disturbance scores is 3.88. This is well beyond the 1 per cent level. For the verbal scores, however, the value of "t" for the difference in final test scores is 1.43. This value of "t" falls between the 10 and 20 per cent level of significance.

In summary, it can be said that the experimental and control groups of both the employed and student subjects were evenly matched on initial scores. In the final test results, all of the differences were found to be significant well beyond the 1 per cent level with the exception of the comparisons in verbal response scores for the student group. For the latter the trend of change was the same as that of the employed group although the difference was not distinctly significant. Since studies of the Luria test tend to show that disturbances in voluntary responses are the more significant as indicators of conflict, and since significant changes in these scores appeared in both groups, we may conclude that the learning program produced significant changes in the experimental groups.

Comparison of Attitude Ratings

As indicated above ratings relative to five attitudes were obtained for the data gathered in the initial interview and on the self-report blank. The initial ratings were compared with final ratings obtained in a similar way at the close of the experiment.

In analyzing attitudes, since the subjects were not paired on attitude scores, the "t" test was applied to the initial and final scores of the control and experimental groups.

TABLE 2

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL TESTS BETWEEN EXPERIMENTAL AND CONTROL GROUPS (STUDENT GROUP)

Measures	N	Means of Differences	Σd^2	"t"	"t" for 1% Level of Significance
			Initial Test		
Voluntary disturbances	28	.85	1953	.12	2.771
Verbal scores	28	.25	1949	.20	2.771
			Final Test		
Voluntary disturbances	28	13.82	9655	3.88	2.771
Verbal scores	28	4.50	3968	1.43	2.771

The data for the employed group show that in no case did the control group gain (Table 3). In *attitude toward parents*, the value of "t" is zero, and for the other four attitudes studied a slight loss from initial to final scores appears though these differences are not significant.

In the employed experimental group, however, gains significant below the 1 per cent level are found in two attitudes,- *attitude toward the place of sex in life* and *attitude toward self-determined goals and standards* (Table 4). The *attitude toward social problems* shows a difference significant well below the 5 per cent level. The differences in the *attitude toward parents* and *social status with the opposite sex* are not significant.

In the student group, we find tendencies to lose on the part of the control group (Table 5) on four out of the five attitudes studied, and some gain in the *attitude of social status with the opposite sex* but none of the differences are significant.

In the student experimental group (Table 6), the data reveal differences significant below the 1 per cent level for three attitudes: *attitude toward place of sex in life*, *toward self-determined goals and standards*, and *toward social problems*. In the *attitude of social status with the opposite sex*, "t" was found to be significant below the 2 per cent level, while the difference in *attitude toward parents* is insignificant.

In conclusion, it can be said that in no case did the control group of either employed or student subjects make a significant gain in attitudes. On the other hand the experimental subjects in both cases showed significant changes. The student experimental group yielded differences well below the 1 per cent level in three attitudes, and a difference for the fourth significant below the 2 per cent level.

In the employed group two of the five attitudes measured showed differences significant below the 1 per cent level. A third, *attitude toward social problems*, yielded a difference significant well below the 5 per cent level. Differences in *attitude toward social status with the opposite sex* and *attitude toward parents* were not significant.

TABLE 3

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES
(EMPLOYED CONTROL GROUP)

Attitudes Measured	N	Means of Differences	d^2	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	25	.00	0	.00	2.797
2. Social status with opposite sex	25	.12	11	-.92	2.797
3. Toward place of sex in life	25	.08	4	-.97	2.797
4. Toward self-determined goals and standards	25	.24	6	-2.40	2.797
5. Toward social problems	25	.16	6	-1.60	2.797

TABLE 4

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (EMPLOYED EXPERIMENTAL GROUP)

Attitudes Measured	N	Means of Differences	d^2	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	25	.20	19	1.17	2.797
2. Social status with opposite sex	25	.40	28	1.61	2.797
3. Toward place of sex in life	25	.48	16	3.00	2.797
4. Toward self-determined goals and standards	25	.40	10	3.33	2.797
5. Toward social problems	25	.24	8	2.18	2.797

TABLE 5

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (STUDENT CONTROL GROUP)

Attitudes Measured	N	Means of Differences	Σd^2	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	28	.14	6	-.15	2.771
2. Social status with opposite sex	28	.18	13	1.38	2.771
3. Toward place of sex in life	28	.035	9	-.35	2.771
4. Toward self-determined goals and standards	28	.43	30	-2.26	2.771
5. Toward social problems	28	.39	43	-1.69	2.771

TABLE 6

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (STUDENT EXPERIMENTAL GROUP)

Attitudes Measured	N	Means of Differences	Σd^2	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	28	.14	16	.94	2.771
2. Social status with opposite sex	28	.28	26	2.54	2.771
3. Toward place of sex in life	28	.67	35	3.14	2.771
4. Toward self-determined goals and standards	28	.50	16	3.57	2.771
5. Toward social problems	28	.57	26	3.16	2.771

The quantitative results may be summarized by saying that significant changes were produced in the experimental groups while no changes appeared in the control groups. It appears that a learning program of the type used in this study can bring about a significant change in the indications of conflict as revealed by the Luria test. It also appears that the learning program can produce significant changes in attitudes.

To obtain an indication of the way in which the learning program may bring about changes in the adjustments of young people several case studies were made. One representative case study will be reproduced here for the reader. Others will be found in Morgan (2).

Employed Experimental Subject #8

Number 8's problem was centered around his father's failure in business and the father's taking to drink. Being engaged and eager to be married, No. 8 felt great frustration at having to support the family. The family received some aid from another son, but the greater burden of support fell on No. 8.

The verbal responses regarding family relationships attained in the administration of the Luria test were studied to see what they reveal regarding No. 8's problem. Some of the responses in the test tend to show his frustrations as well as his desires or goals:

Stimulus Word	Responses
sin	drinking
liquor	bad
school debt	not paid
job	wages
lasting satisfactions	job
security	happiness
ideas worth living for	home
desire	job
sign of success	marriage

In his initial interview, in speaking of managing money, No. 8 burst out with,

> "If Dad were working it would be different. I like to save money. I like to put it in the bank. But, here I am this week with less than a dollar in my pocket. I spent $1.50 for gas for my brother's car; have seen one movie; and the rest has gone to the family. It had to."

"I want a good job which is secure," was No. 8's reply to the experimenter's question about what he hoped to be doing at thirty-five years of age. He told of having taken Civil Service Examinations four months before hoping to become a meat inspector.

> "I want to be married and have a family as I am engaged now, and we have been dating steady for nearly four

> years. Four or five years ago my father had a meat business of his own. It went bad and he sold it and the money is gone too! Next he wanted to go on the road selling meat equipment. The selling game is o.k. on a salary with commission but just a commission as Dad is getting doesn't work. He makes nothing and the family are on my brother and me."

His happiest and most unhappy experiences appeared revealing. His most unhappy experience was when his father started drinking when his business "went bad."

> "He doesn't drink now, but it surely played havoc."
> "A happy experience? When was I on top of the world? Let me see...When I got my bicycle...In those days my father had a lot of money."

Number 8 told the experimenter that he did not think everyone had a square deal:

> "I attended college at ——— for one year. Believe me, I worked for it, worked at a gas station nights. In addition I worked out my tuition by mowing college lawns and painted college walls. The experiences I ran into didn't seem quite fair. Fellows with money to throw away all around me and they didn't make use of their opportunities. It was awful. I stuck it out for a year, but quit. Too, I had to help support the family."

During the group discussion of family relationships, No. 8 contributed very little. Several subjects told of families they knew where the father's loss of job or failure in business had caused utter loss of confidence on the part of the parents. We talked at length of the depression doing things to people for which they, themselves, were not responsible. One could not tell, though, what No. 8 was thinking.

In spite of No. 8's seeming bitterness regarding money and lack of economic security, he was a charming man to know. From things he said, it was evident that his childhood and youth up to the time of his father's failure in business had been a fine experience.

Socially, he was one of the outstanding men of the employed group, being liked by everyone. His contributions to discussion were objective and helpful. For example, someone said it would not be at all wise for a man who was not a college man to marry a woman who had been privileged to attend college. It was quite evident from the amount of emotion displayed that the majority of the group felt inferior because of lack of higher education. No. 8 said, in his calm way,

> "I don't believe you folks are thinking straight on that. It would depend on the two people. Of course, I know the culture pattern is otherwise, but if the man were

> fairly mature and they understood and loved each other, it could be done."
>
> ...
>
> Later after the group had calmed down, No. 8 said,
>
> "I, myself, am going to marry a girl who finished college this spring and I have had only one year of college." (No. 8 brought his fiancee to the last meeting of the group so that they might meet her.)

Because he knew the experimenter was interested in the results of his civil service examinations, he reported every week:

> "I haven't heard yet. But no news is good news. Keep your fingers crossed."

One night he did not report, but the experimenter did not inquire, fearing that he had not passed. When he came for his teaching conference two weeks later, he reported that he had not passed the examinatio

> "I'm not going to let it get me down, though. I am liking my present work better all the while and there is a chance to advance in it."
>
> As we talked on, No 8 said,
>
> "The thing that did the most for me in this group was seeing my father's failure in business and his starting to drink all as a part of a larger social and economic problem. Why, Mrs. M----, as I thought it through, I'm sure he began drinking because he couldn't stand to face the failure. Of course, it just made matters worse when we lost what little money we had left. Always before, though, I had blamed him alone and never once thought of the situation...
>
> "Understanding how it might have happened took all of the bitterness away. The family is doing better all around, now. ...
>
> "You must have thought I was a great one to 'blow off' to you the way I did the first night."
>
> An experimenter commented:
>
> "At times we need a person outside the family with whom to talk over things that trouble us. It helps to put problems into words, sometimes. You are making spendid progress now."

About two months later, when No. 8 came to take his final test he related to the experimenter the following:

"We have bought a car together. He uses it for his work during the week and it is mine for weekends. It is just a used car. The finance corporation wouldn't let Dad have it unless I was a part of the deal. ...

"Gosh, but that must hurt a man who owned a good business once!

"At one time I would have rubbed it in, but now that I understand better I told him I was wanting a car, too. Neither of us could afford it alone, this was a real opportunity to go in together on it."

These data tend to indicate that as the subject gained insight and understanding of the possible causes of his father's behavior new ideas were available to him for working out a method of assisting the father and at the same time fulfilling his own desires.

Summary

In this study a learning program designed to develop an understanding of behavior in marriage, family and social relationships was administered to two experimental groups of young people. Each experimental group was paralleled by a matched control group. Measurements of conflict and selected attitudes were obtained before and following the administration of the learning program. A total of 106 subjects was used.

An analysis of the results indicated that the learning experiences were effective in the reduction of conflicts as measured by the Luria test and in producing significant changes in attitudes.

An analysis of individual records yielded qualitative data indicating in more detail the nature of the changes.

From both the quantitative and qualitative data it appears that signigicant changes can be made at the upper age levels through a learning program of the type used in this study. The significance of this finding is far-reaching. If the course of development of the relationships to others can be altered by methods now under our control, most significant consequences follow for the guidance of adolescents and youth.

In exploring this problem the limitations of our knowledge as to how to produce changes at the upper age levels must not be overlooked. We have some data to show that changes can be made. But how the changes can be made most efficiently, whether more powerful methods can be devised and at what point in the individual's life cycle various methods can be most effectively applied -- these are some of the problems that must be subjected to extended study if we are to have effective programs in this area. A study on the high school level using high school juniors and seniors as subjects has produced results similar to those of this study. How far down in the educational scale we can go is not known.

We must also know more about how learning programs produce the changes we have noted. In case study No. 8 reported as a sample it can be seen that as the subject gained insight into and understanding of the possible causes of his father's behavior new ideas were available to

No. 8 and from these he could work out a plan to assist the father and at the same time to fulfill his own wants. There may, of course, be other paths by which the learning program produces its effects. Detailed studies are needed to reveal the many possibilities.

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THE GROWTH OF BONE, MUSCLE AND OVERLYING TISSUES IN CHILDREN SIX TO TEN YEARS OF AGE AS REVEALED BY STUDIES OF ROENTGENOGRAMS OF THE LEG AREA

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A method has been described (1) for the evaluation of the relative amounts of the three principal tissues of the body from the study of an x-ray film of the leg. The three tissues differentiated by film shadow densities are cutaneous-subcutaneous, muscle and bone. The method is applicable to children from 3 months to 7 years of age. This evaluation aids in interpreting body measurements such as height and weight and throws light on the state of nutrition. It helps especially to distinguish between amounts or increments of weight due to accumulation of fat and those attributable to stockiness of bones or development of muscles. It has been found to be a valuable adjunct to clinical examination and other approaches to the study of children (1, 2, 3).

The method previously described involves taking an antero-posterior roentgenogram of the leg, including knee and ankle, with the tube set at three-foot distance and following certain simple but important precautions as to the positions of tube, parts and film, and as to exposure. The tibial shaft area of film is then bounded by prescribed lines, and the tissue shadows within these lines are outlined. Tibial length and certain breadth measurements are first taken and then areas of tissue shadows are cut out and weighed on a chemical balance.[2] The earlier publication, therefore, made available a method of measuring, as well as norms for certain linear dimensions and certain areas of tissue shadows for young children. These procedures were found to give reliable results and to reveal characteristics of build for age and sex, as well as individual differences in these respects.

In the study of children over 6 or 7 years of age, it was found advisable to make certain changes in the technique to be followed, due to the increased length of the leg and to changes taking place at the lines of union of shaft and epiphyses. A new technique was, therefore, developed differing principally in the use of a six-foot tube distance and in the adoption of somewhat different criteria for the demarcation of the tibial shaft area. New norms have been developed, using these modifications of the earlier technique in studying children from 6 to 10 years of age inclusive. The establishment of norms by both techniques for children of 6 and 7 years allows for overlapping by the two methods in following individual children. Table 1 gives the figures obtained by

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[1] *From the Department of Child Hygiene, Harvard School of Public Health and the Department of Pediatrics, Harvard Medical School. From studies made possible by a grant from the General Education Board of the Rockefeller Foundation. This is a second report describing a technique developed for the study of the growth of these tissues and giving norms based upon studies of a series of children. The former report (1) dealt with children up to 7 years of age.*

[2] *The following summary gives the technique recommended for the study of young children, but the reader who intends to apply this technique is urged to study the more detailed description given in the previous report (1).*

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TABLE 1

COMPARISON OF THE MEDIANS OF THE FIRST TECHNIQUE AND THE SECOND TECHNIQUE AT SIX AND SEVEN YEARS OF AGE

Measurement	BOYS				GIRLS			
	Six Years		Seven Years		Six Years		Seven Years	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Length of Tibial Shaft	22.1	21.3	23.6	23.1	22.3	21.9	24.0	23.0
Breadth of Calf	8.0	7.9	8.0	8.1	8.2	8.2	8.6	8.5
Breadth of Muscle	6.9	6.6	7.1	6.9	6.8	6.9	7.2	7.1
Breadth of Tibia	1.7	1.7	1.8	1.8	1.7	1.7	1.8	1.8
Total Area*	146.8	133.0	157.6	150.8	152.9	143.1	174.5	161.5
Bone Area*	60.3	57.6	66.5	65.4	60.8	58.0	67.7	63.8
Muscle Area*	56.5	52.9	61.5	59.2	55.9	55.0	63.3	62.2
Skin + Subcutaneous Area*	24.5	23.2	25.2	24.3	31.1	30.0	33.2	33.4
Bone Area as percentage of Total	42.2	43.4	43.8	44.3	41.0	40.6	40.8	41.3
Muscle Area as percentage of Total	40.0	39.6	39.5	40.6	38.3	38.6	38.7	38.6
Skin + Subcutaneous Area as percentage of Total	17.2	17.2	16.8	16.6	21.2	20.8	20.5	20.4

*Values for these measurements of Areas by the First Technique are weights of film shadows multiplied by the conversion factor, 31.06.

both methods at these ages and shows that the measurements obtained by the young child or first technique are uniformly slightly larger than those obtained by the older child or second technique, due to elimination of distortion in the latter instance. The measurements themselves, therefore, should be related to the appropriate norms rather than compared directly. The table, however, shows that the percentages of total area represented by each tissue area are very similar for the two methods.

The measurements of tissue shadow areas used in developing these new norms for the older children have been obtained by use of a planimeter, in part because it has been found to save time, but principally to preserve the x-ray films for other purposes.

It is the purpose of this report to describe the technique to be adopted in the study of children 6 to 10 years of age and to present norms suitable for use in evaluating the various dimensions and tissue shadow areas at these ages. The norms previously published are still recommended for use with children from birth to 6 years.[3]

Footnote 2 continued from Page 195

The child lies flat on his back on the x-ray table, with both ischiae resting evenly without internal or external rotation, with the right leg fully extended at the knee, with the calf relaxed and resting gently on the table, and with the foot held perpendicular to the table. Since complete extension at the knee joint and near parallelism between leg and film are essential to accuracy, it is customary to have the assistant exert moderate pressure over the lower thigh with the left hand, while supporting the foot with the right.

The x-ray tube is centered over the broadest part of the calf and at three-foot distance from the film cassette. The latter must be long enough and so placed as to include the full length of the tibia and breadth of the calf on the film. The exposure must be such as to allow clear visualization of the outlines of skin, muscle and bone throughout the length of the tibial shaft. Using 100 milliampere current and 1/20 second exposure through 4½ years and 1/10 second exposure from 5 to 7 years, the voltage is varied in accordance with the thickness of the extremity.

Measurements are obtained from these films in the following manner: The mid-points on lines crossing the heads of the diaphyses of the tibia are marked, and a line is drawn through these two mid-points. Where this line leaves the diaphyses of the tibia at either end, transverse lines are drawn perpendicular to the original line. Some of the shafts of tibia and fibula are visible beyond these demarking lines and some of the epiphyses are included between them, but only the area included is studied.

The distance on the original longitudinal line bounded by the two transverse lines is measured and referred to as Tibial Length or Length of Tibial Shaft. This length is multiplied by a constant 0.3 and the product is laid off on the longitudinal line, measuring from the upper or proximal transverse line. A third transverse line, parallel to the others is drawn across the calf at this point and represents the greatest width of calf. This has been found to correspond to the greatest breadth at all ages under study, because the latter is not represented by a point on the external contours of the calf but rather by a zone.

Breadth of Calf, which is the breadth of the total area, Breadth of Muscle, which includes the bones and is Breadth of Calf less the two layers of skin and subcutaneous tissue, and Breadth of Tibial Shaft are measured directly on the middle transverse line. Breadth of Skin + Subcutaneous Tissue is derived by subtracting Breadth of Muscle from Breadth of Calf.

Following the determination of linear measurements, the tissue shadows are outlined. The total area is first cut away from the rest of the film, and the film representing this area is weighed. The skin + subcutaneous tissue shadow is then cut away from the muscle and the combined bone and muscle area of film is weighed. Finally the film shadows of the two bones are cut out and weighed together. Weights are taken on a chemical balance to ten milligram values. Weight of Total Area, Weight of Combined Bone and Muscle, and Weight of Bone are thus available directly. Weight of Skin + Subcutaneous Tissue is derived by subtracting Weight of Combined Bone and Muscle from Weight of Total Area, and Weight of Muscle is derived by subtracting Weight of Bone from Weight of Combined Bone and Muscle.

It must be emphasized that the measurements here described are of projection images, cast on films under standard conditions, and the values must not be thought of as actual values for anatomical sections of these parts.

[3] *The norms previously published give values for areas of tissue shadows in terms of the weights of the film segments representing them. As comparison of these values with those for actual areas necessitates multiplication by the factor 31.06 and may cause confusion for those using both sets of norms, the values for the earlier ages are given as areas in Table 12 at the end of this article. The figure given on page 13, line 2 of the previous report for this conversion factor is in error and should be changed to read 31.06.*

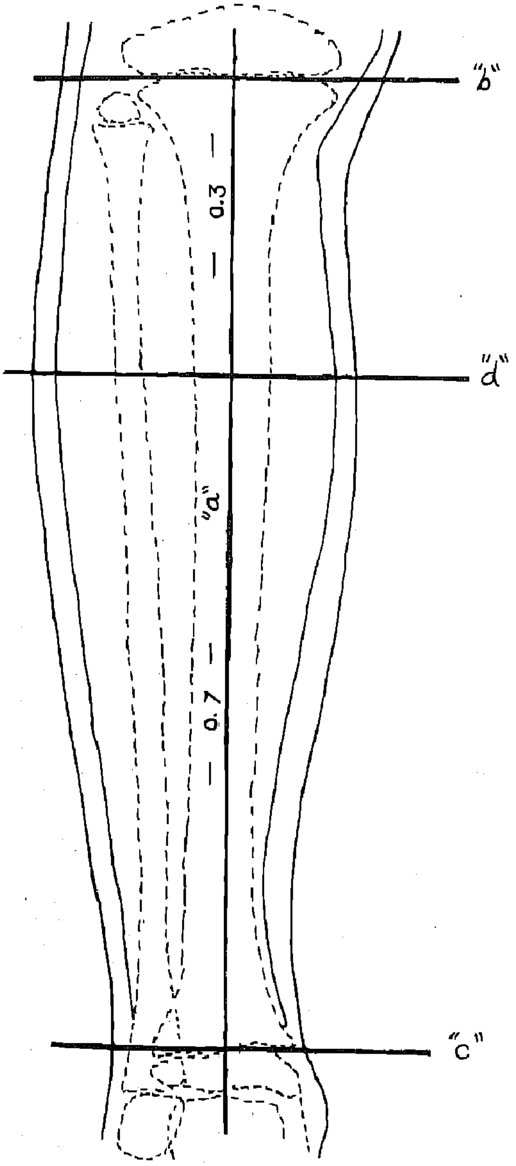

Figure 1. Tracing of Roetgenogram Showing Lines Used for Measurements. Antero-posterior view of right leg of a boy, age 7 years: "a" = vertical line bisecting heads of diaphyses; "b" = upper transverse line, perpendicular to "a" at upper end of tibial shaft; "c" = lower transverse line, perpendicular to "a" at lower end of tibial shaft; "d" = transverse line, parallel to "b" and "c" three-tenths length of tibial shaft below "b", representing greatest breadth of calf.

Modifications of Technique Adopted for Study of Older Children

The film is exposed under identical conditions of tube centering, leg position and position of cassette as described in Footnote 2 for the young child technique, but the distance between the focal point of the tube and the cassette is now extended to 6 feet. This in practice usually requires having the child lie on the floor, rather than on the x-ray table. It also involves certain changes in exposure. We have used a 65 milliampere current and a 0.25 second exposure, and have varied the voltage according to the size of the calf, the range being between 40 and 45 peak kilovolts. The principal advantage in the six-foot distance is that the distortion of shadows at these ages is considerably reduced, and it renders the image measurements much more like those of the anatomical parts.

The second point of difference in the older child technique has to do with locating the end points of the tibial shaft, which at these ages are becoming confused by the early stages of union with epiphyses. A vertical line (a, Figure 1) is drawn between the mid-points of the heads of the diaphyses. A ruler edge is held so that it passes through the notches formed by the diaphyseal heads and the epiphyses, and lines (b, and c, Figure 1) are drawn at right angles to the vertical line at the points where the ruler intersects the latter. The distance between these two horizontal lines is measured and gives the Length of Tibial Shaft. This figure is multiplied by 0.3, and a third line (d, Figure 1), parallel to the two horizontals, is drawn at a point on the vertical line this distance below the upper horizontal. The width of the calf measured on this line (d) has been found to represent the greatest width quite as well with these older children as it did at the earlier ages.

The planimeter is then used over an illuminating box to trace the outlines of the tissues and thus determine their areas. We have achieved greater accuracy and ease of operation by measuring the areas above and below the mid-line separately and then totaling the results. Two determinations are made of each tissue area, and if there is a difference of more than six-tenths of a square centimeter in the results, the measurements are repeated.

If a person desiring to make an evaluation of the leg tissues of an older child is not equipped with a planimeter, he may cut out and weigh the several tissue shadows, as described in Footnote 2 and multiply these weights by the factor 31.06 to find the actual areas in square centimeter values.

Tables 2 to 10 inclusive give the tenth and ninetieth percentiles, as well as the medians for each year of age from 6 through 10 for each of five linear and four area measurements. Length of Tibial Shaft and all breadth measurements are taken directly, except that of Skin + Subcutaneous Tissue, which is derived by subtracting Breadth of Muscle from Breadth of Calf. Total Area, Area of Bone and Muscle and Bone Area are measured directly, and from these Muscle Area and Skin + Subcutaneous Area are derived. The three percentiles chosen for presentation have been found satisfactory for practical purposes in evaluating measurements obtained on children. Table 11 gives the figures for the per cent of the total area of the leg represented by each of the three tissues.

Accompanying each table is a figure of corresponding number designed to portray the trend of growth in each tissue during this age period, as well as any sex differences. In the main, the trends of growth at this time appear to plot as straight lines.

Length and Breadth of Tibial Shaft (Figures 2 and 4) show little difference between the sexes during these years. It appears that girls fail to keep up with boys in amount of muscles, as shown in Breadth of Muscle and Muscle Area (Figures 5 and 9), tending to be on the average somewhat ahead at 6 years and somewhat behind at 10 years.

The curves for Breadth of Skin + Subcutaneous Tissue and Skin + Subcutaneous Area (Figures 6 and 10) show marked and consistent sex differences at all ages and obviously represent a fundamental difference in build. The medians, as well as the tenth and ninetieth percentiles, all plot at a considerably higher level for girls than boys. In fact, the tenth percentile for girls is usually quite near to the fiftieth for boys, and the median for girls sometimes exceeds the ninetieth percentile for boys. This difference was also observed at earlier ages, as noted in the previous report, and is clearly demonstrated in Figure 11, portraying the percents of total area represented by each tissue. In this figure, the girls show consistently a smaller percentage of total area than boys, represented by both bone and muscle, and a larger percentage by skin and subcutaneous tissue.

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TABLE 2

LENGTH OF TIBIAL SHAFT

BOYS					GIRLS			
No.	Percentiles 10th	50th	90th	Age in Years	Percentiles 10th	50th	90th	No.
59	19.68	21.25	22.91	6	20.12	21.87	23.70	58
73	20.95	23.05	24.67	7	21.52	22.98	25.45	63
64	22.44	24.61	26.36	8	22.80	24.50	27.15	52
45	23.58	26.17	28.15	9	24.21	25.82	28.58	37
25	24.70	27.41	29.17	10	25.10	27.43	29.80	24

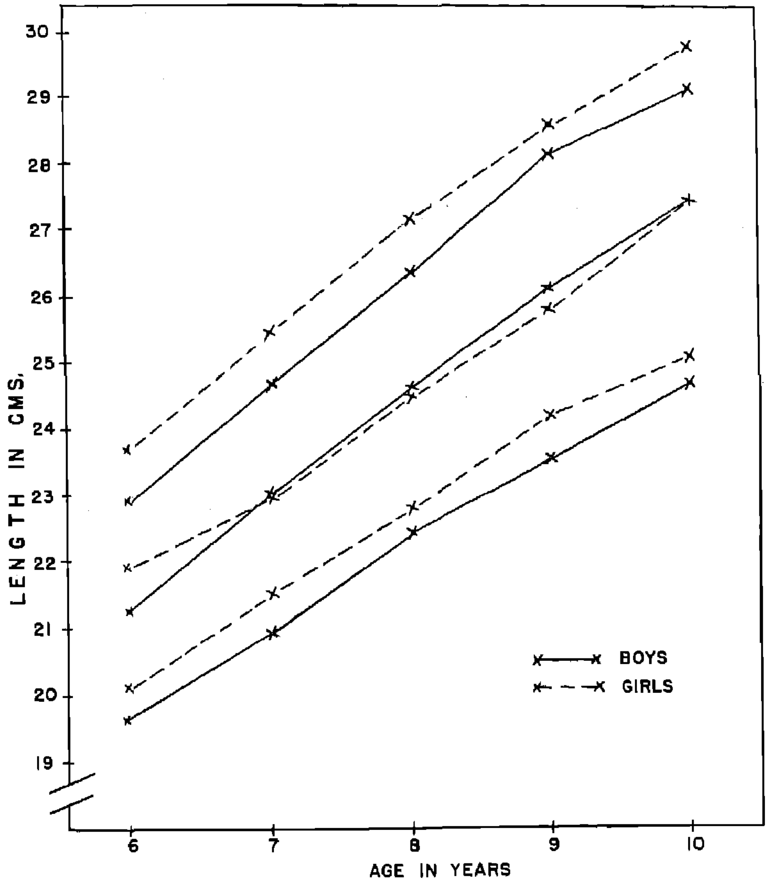

Figure 2. Length of Tibial Shaft. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 3

BREADTH OF CALF

	BOYS				GIRLS			
No.	Percentiles 10th	50th	90th	Age in Years	Percentiles 10th	50th	90th	No.
59	7.04	7.87	8.71	6	7.24	8.20	8.72	58
73	7.21	8.09	9.22	7	7.52	8.46	9.04	63
64	7.62	8.43	9.46	8	7.73	8.60	9.54	52
45	7.82	8.66	9.88	9	8.02	8.70	10.06	37
25	7.83	8.79	10.17	10	7.80	8.75	10.80	24

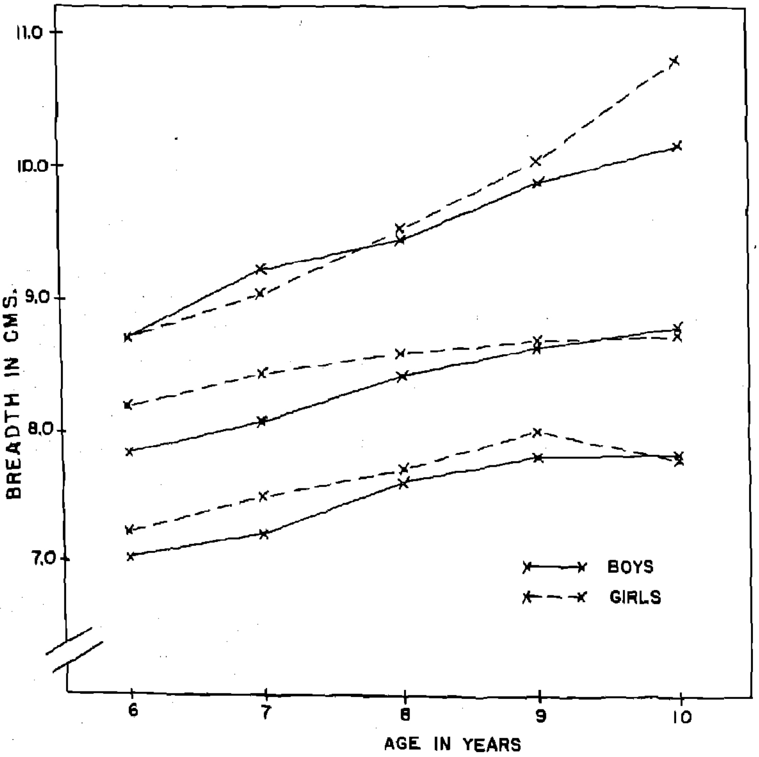

Figure 3. Breadth of Calf. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 4

BREADTH OF TIBIAL SHAFT
(AT GREATEST BREADTH OF CALF)

	BOYS				GIRLS			
No.	Percentiles 10th	50th	90th	Age in Years	Percentiles 10th	50th	90th	No.
59	1.62	1.72	1.99	6	1.60	1.75	1.94	58
73	1.77	1.84	2.04	7	1.66	1.84	1.99	63
64	1.76	1.94	2.13	8	1.71	1.90	2.07	52
45	1.85	2.01	2.29	9	1.77	1.97	2.15	37
25	1.91	2.15	2.35	10	1.83	2.04	2.23	24

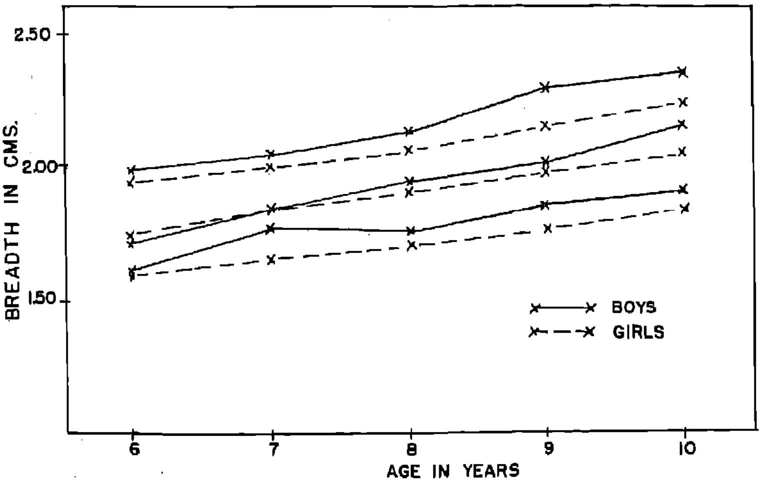

Figure 4. Breadth of Tibial Shaft. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 5

BREADTH OF MUSCLE
(TOTAL WIDTH, INCLUDING BONE SHADOWS AT GREATEST BREADTH OF CALF)

BOYS					GIRLS			
No.	Percentiles 10th	Percentiles 50th	Percentiles 90th	Age in Years	Percentiles 10th	Percentiles 50th	Percentiles 90th	No.
59	6.06	6.60	7.68	6	6.09	6.94	7.48	58
73	6.35	6.92	8.02	7	6.42	7.13	7.91	63
64	6.60	7.26	8.20	8	6.49	7.25	8.28	52
45	6.88	7.64	8.67	9	6.64	7.38	8.46	37
25	7.10	7.72	8.85	10	6.69	7.50	8.72	24

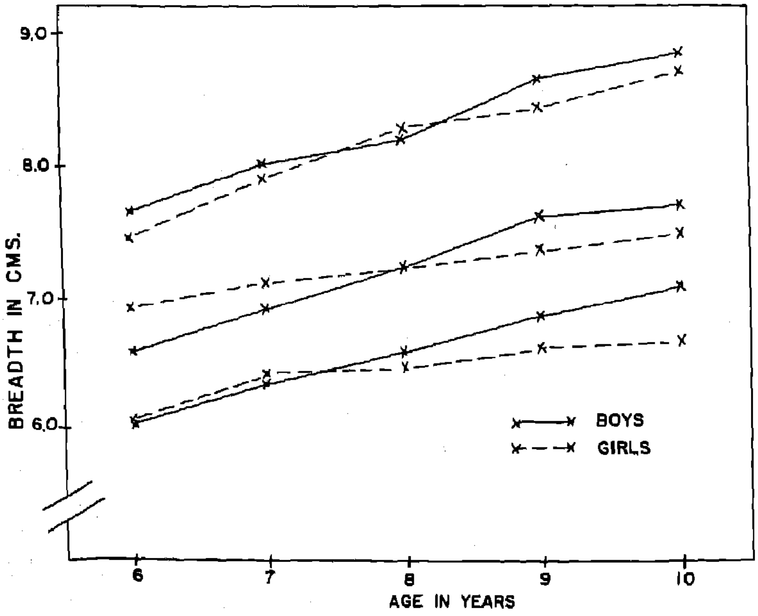

Figure 5. Breadth of Muscle. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 6

BREADTH OF SKIN + SUBCUTANEOUS TISSUE

BOYS					GIRLS			
No.	Percentiles 10th	50th	90th	Age in Years	Percentiles 10th	50th	90th	No.
59	0.78	1.06	1.34	6	1.02	1.35	1.71	58
73	0.76	1.04	1.39	7	1.00	1.32	1.69	63
64	0.82	1.06	1.45	8	1.12	1.35	1.79	52
45	0.81	1.06	1.45	9	1.12	1.33	1.93	37
25	0.82	1.11	1.46	10	1.12	1.38	1.86	24

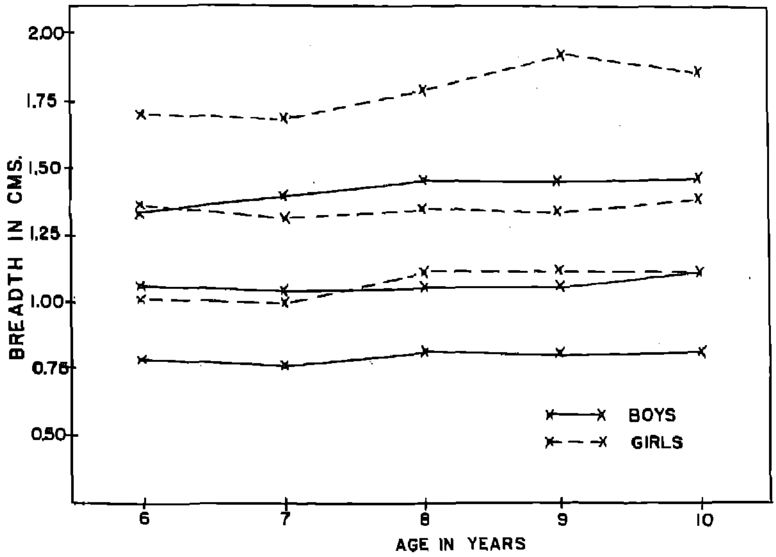

Figure 6. Breadth of Skin + Subcutaneous Tissue. 10th, 50th and 90th percentiles from six through 10 years.

TABLE 7

TOTAL AREA
(AREA OF SHADOW OF TOTAL SEGMENT)

	BOYS				GIRLS			
	Percentiles				Percentiles			
No.	10th	50th	90th	Age in Years	10th	50th	90th	No.
59	117.2	133.0	157.8	6	119.8	143.1	167.8	58
73	130.7	150.8	178.5	7	131.3	161.5	186.2	63
64	145.3	168.3	199.0	8	145.2	170.0	208.0	52
45	155.6	183.0	223.8	9	156.7	183.7	227.1	37
25	161.0	189.0	227.5	10	164.7	196.6	253.0	24

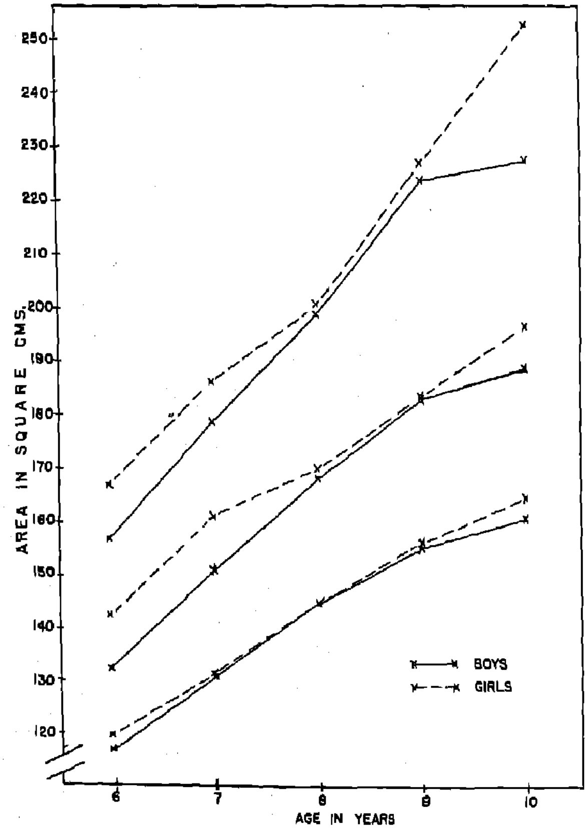

Figure 7. Total Area. 10, 50th and 90th percentiles from 6 through 10 years.

TABLE 8

BONE AREA
(AREA OF SHADOWS OF BOTH BONES)

BOYS					GIRLS			
No.	Percentiles 10th	Percentiles 50th	Percentiles 90th	Age in Years	Percentiles 10th	Percentiles 50th	Percentiles 90th	No.
59	51.0	57.6	67.4	6	49.9	58.0	67.2	58
73	57.1	65.4	76.6	7	54.8	63.8	76.8	63
64	64.8	73.4	86.0	8	60.3	71.6	84.8	52
45	70.5	81.3	96.0	9	65.4	80.0	93.3	37
25	73.0	87.2	103.0	10	68.5	86.2	99.3	24

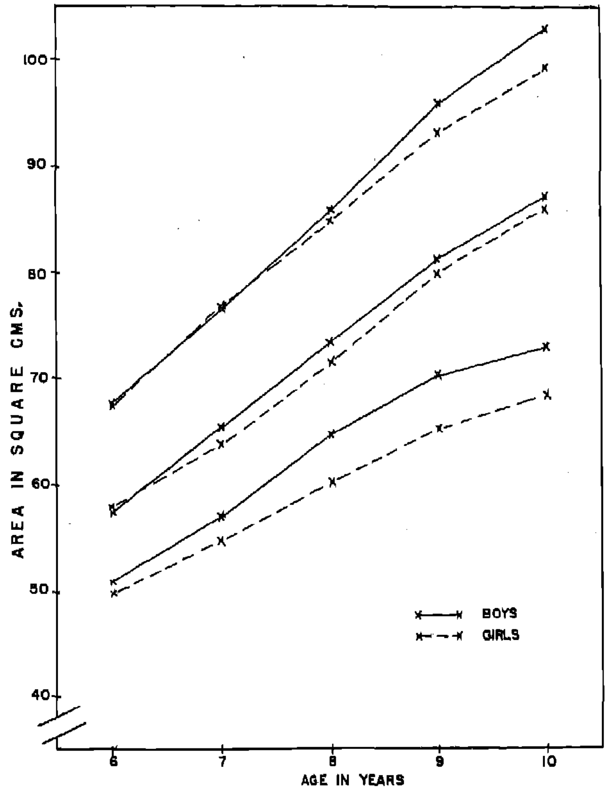

Figure 8. Bone Area. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 9

MUSCLE AREA
(AREA OF SHADOWS OF MUSCLES, NOT INCLUDING BONES)

BOYS					GIRLS			
No.	Percentiles 10th	Percentiles 50th	Percentiles 90th	Age in Years	Percentiles 10th	Percentiles 50th	Percentiles 90th	No.
59	45.2	52.9	65.4	6	43.4	55.0	66.2	58
73	50.8	59.2	69.8	7	49.2	62.2	74.4	63
64	55.1	66.0	79.1	8	51.6	66.9	80.8	52
45	61.2	71.8	86.3	9	56.7	70.0	84.4	37
25	61.9	74.4	89.2	10	56.0	72.5	89.3	24

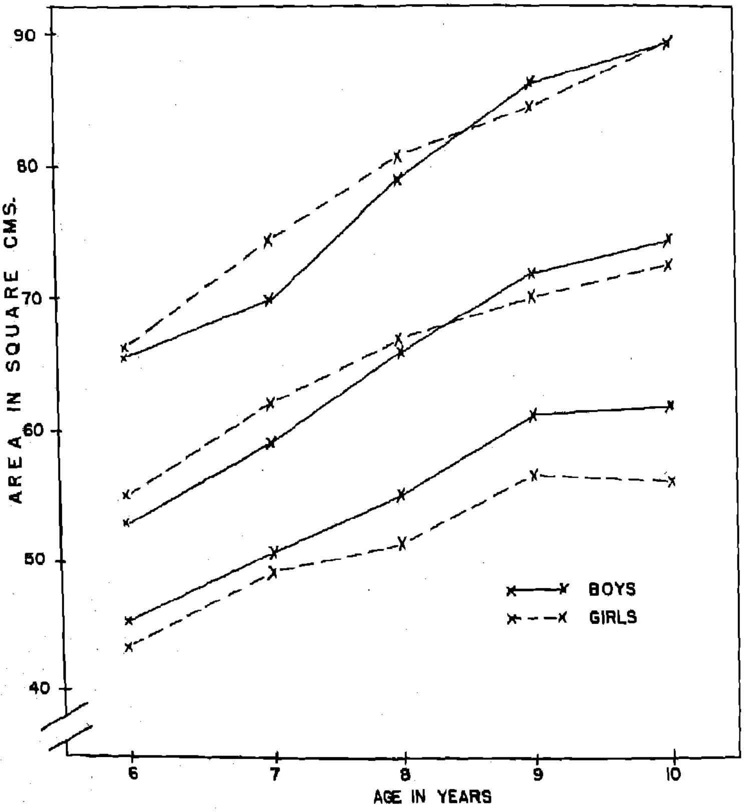

Figure 9. Muscle Area. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 10

SKIN + SUBCUTANEOUS AREA
(AREA OF SHADOWS OF SOFT TISSUES OVERLYING MUSCLES)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	16.8	23.2	30.1	6	21.2	30.0	39.2	58
73	17.6	24.3	33.7	7	22.8	33.4	41.6	63
64	19.4	27.5	38.2	8	26.1	34.0	47.3	52
45	19.8	27.7	44.9	9	28.9	38.2	54.6	37
25	21.3	30.5	45.0	10	31.4	38.7	63.0	24

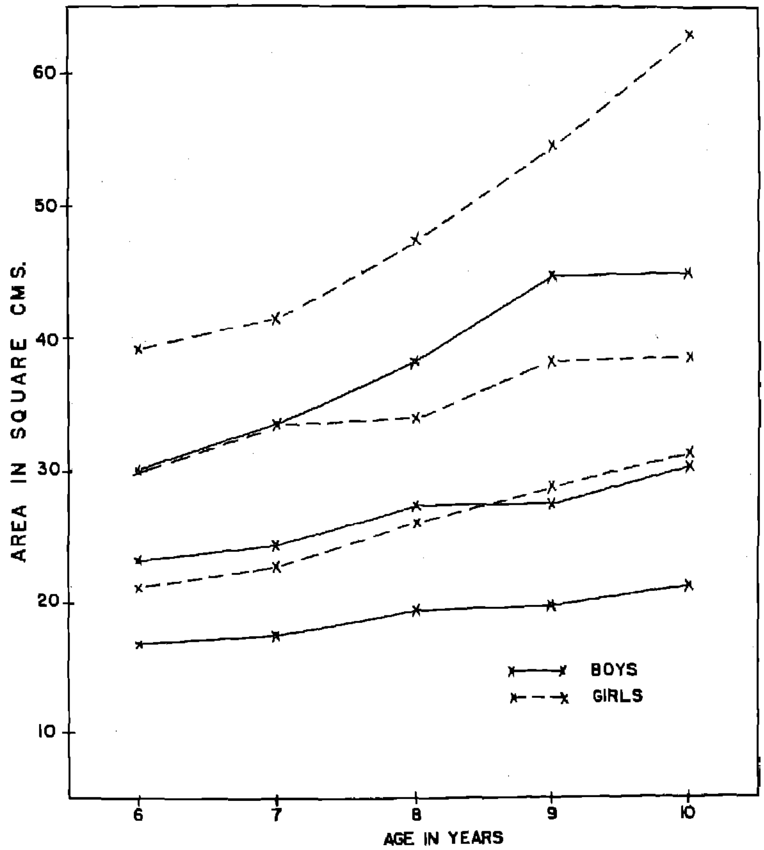

Figure 10. Skin + Subcutaneous Area. 10, 50th and 90 percentiles from 6 through 10 years.

TABLE 11

TISSUE AREAS AS PERCENTS OF TOTAL AREA

				BONE AREA				
	BOYS				GIRLS			
No.	Percentiles 10th	50th	90th	Age in Years	Percentiles 10th	50th	90th	No.
59	41.3	43.4	47.2	6	37.6	40.6	44.4	58
73	40.2	44.3	48.0	7	37.7	41.3	45.2	63
64	40.1	44.4	48.1	8	37.8	41.6	45.7	52
45	40.9	45.1	48.7	9	38.6	41.8	46.3	37
25	40.7	45.5	48.8	10	37.4	42.3	47.0	24
				MUSCLE AREA				
59	36.2	39.6	43.1	6	33.9	38.6	41.9	58
73	35.1	40.6	42.6	7	33.7	38.6	42.4	63
64	35.3	39.2	43.3	8	34.0	37.9	41.9	52
45	34.6	38.2	43.3	9	34.3	37.5	41.6	37
25	34.8	38.4	43.5	10	31.0	36.6	42.0	24
				SKIN + SUBCUTANEOUS AREA				
59	13.6	17.2	21.3	6	16.6	20.8	24.7	58
73	12.7	16.6	20.9	7	16.2	20.4	24.9	63
64	12.4	16.6	20.9	8	16.5	20.5	24.7	52
45	11.9	16.1	21.1	9	16.5	19.9	26.3	37
25	12.2	16.2	20.5	10	16.2	20.8	24.8	24

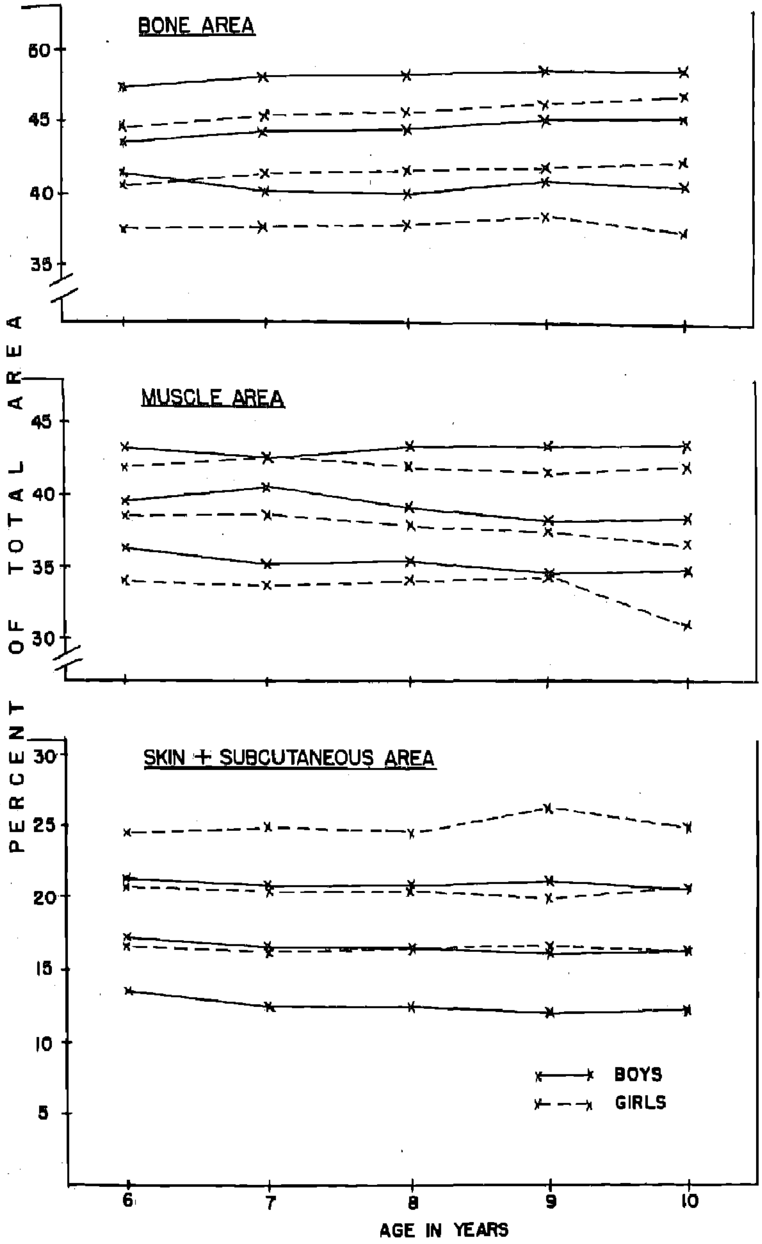

Figure 11. Tissue Areas as Percentages of Total Area: Bone Area; Muscle Area; Skin + Subcutaneous Area. 10th, 50th, and 90th percentiles from 6 through 10 years.

A STUDY OF THE McCLOY METHOD FOR DETERMINING NORMAL WEIGHT

MARY M. CLAYTON[1]

Ever since Emerson (1) began his nationwide attempt to improve the nutrition of American children by bringing them up to "normal" weight, physicians and other health workers have realized that there are fallacies in the method. One of the greatest of these is that the use of standard tables based on averages for age, height, and weight gives only a wide zone of normality and necessarily introduces errors into the determination of standard weights for children having skeletal builds which differ from the average.

Numerous attempts have been made to work out more accurate methods for determining normal weight which would make use of other skeletal measurements besides height. As early as 1886 Bornhardt (2) used chest circumference, together with height, in the prediction of the body weight of adults. In 1919, Dryer (3) used chest girth and stem length. Of these two methods Gray and Root (4) found the latter more accurate in predicting the normal weight of adults. In preparing his ideal weight tables for boys, Gray (5) used an average of weight for stem and weight for chest. Lucas and Pryor (6) advocated the use of bi-iliac diameter and height and in 1936 Pryor (7) published her width-weight tables. These have recently (8) been revised to make use of measurements of bi-iliac diameter, chest width (nipple level), and height.

The above workers did not attempt to correct their measurements for subcutaneous fat. As McCloy (9, p. 67) points out, the inclusion of fat would introduce errors which would increase in proportion to the thickness of the fat over the bones involved.

The McCloy Method

In his method for determining normal weight McCloy (9, 10) uses measurements of height, chest circumference at the xiphoid level (corrected for fat), bi-iliac hip width (corrected for fat), and knee width (not corrected for fat). By statistical methods he found these measurements to be closely correlated with weight. His reason for making the chest measurement at the xiphoid level, in preference to the level of the 4th costo-sternal articulation, is that it is an easy one to secure in both males and females and is below the scapulae and the largest muscle bulks of the chest. Also, in the majority of individuals, fat at this level is easily measured by the use of the subcutaneous tissue calipers devised for the purpose. The choice of hip width at the iliac crests in preference to the level at the greater trochanters was made in order to avoid the thick fat pads in the latter location. The supra-iliac fat is also measured with the fat calipers.

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[1] *From Maine Agricultural Experiment Station, Orono.*

Use of Method in Present Study

The McCloy method for determining normal weight was recently (1936-40) used by the writer in a 4-year study of the nutritional status of grade-school children in Newport, Maine. In this study, measurements were made fall and spring on all of the children in the school (approximately 230). During the 4 years 1849 sets of measurements and calculations of normal weight were made. The method was also used in the fall of 1940 and 1941 on 263 college freshman girls. The results were used in the present study in order to show how the McCloy weight standards apply to Maine children whose skeletons are, in general, somewhat narrower than those of the Iowa children who were used in working out the standards; to show how they compare with the Baldwin-Wood and new Pryor (8) standards; and to give some evidence regarding the reliability of the McCloy weight indices as applied to children having widely differing types of bony skeletons and amounts of subcutaneous tissue.

In the determination of normal weight it was McCloy's intention to make use of measurements which, when corrected for fat, would be approximately those of persons weighing the correct amount for their age, sex, and skeletal builds. There is no way of testing the true accuracy of the fat corrections on living persons, but the validity of the determinations of normal weight has been studied by the writer in a number of ways.

Relationship Between McCloy Weight Indices and Nutrition Estimates

The first method used was to study the relationship between the McCloy weight indices $(\frac{\text{actual weight}}{\text{normal weight}} \times 100)$ and estimates of nutrition[2] of the Newport children as made by the writer in the spring of 1940. This was done by determining Pearson's coefficient of contingency (Love, 11, p. 165). In determining this coefficient the weight indices were grouped as follows, according to the suggestions for judging underweight and overweight made by McCloy (10, p. 110):

116.01 and above	(overweight)
108.00 - 115.00	(slightly overweight)
96.01 - 107.99	(normal range)
96.00 - 94.00	(slightly underweight)
93.99 and below	(underweight)

Nutrition estimates were grouped as follows: overweight, slightly overweight, good, fair, poor.

For 108 boys the coefficient of contingency was .765; S.E. ± .040 and for 102 girls it was .610; S.E. ± .062. It thus appears that there was fairly good correlation between the McCloy weight indices and the estimates of nutrition. The failure to secure as good correlation in the girls as in the boys may be explained as probably due to the fact many of the girls tended to be somewhat underweight, but the examiner became so accustomed to seeing them that they were sometimes rated as

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[2] *In making the nutrition estimates other factors than weight were considered, but weight was one of the most important. The condition of the teeth and gums was not included.*

"normal". On the other hand, those who were actually normal, or merely slightly overfat, were sometimes rated as "slightly overweight". She is of the opinion that, except in a small percentage of cases (to be discussed later), the McCloy weight indices are more accurate than her own judgment of weight. These probable errors in judgment, together with the fact that other factors than weight were included in the nutrition estimates, could explain the lack of perfect correlation.

McCloy Fat and Limb Girth Indices

The McCloy system of appraising physical status also includes methods for determining normal fat and normal limb girth. Therefore, both fat and limb girth indices may be determined. Used together with the weight index, these indices are of use in determining whether or not a child has a normal distribution of muscle and fat.

In the determination of the fat index[3] 4 fat measurements (chest front, chest back, abdomen, and supra-iliac)[4] are taken and the sum compared with averages for each age and sex.[5]

Limb girth indices $(\frac{\text{actual limb girth}}{\text{normal limb girth}} \times 100)$ are determined by use of measurements of the girths of chest, upper arm, fore arm, thigh, and calf and the widths of elbow and knee. Standards for each age and sex are based on these same measurements.

Relationship Between Fat and Limb Girth Indices and Nutrition Estimates

The relationships between the McCloy fat and limb girth indices and the estimates of nutrition were also studied by the determination of the coefficients of contingency. The results were as follows:

Fat indices and nutrition estimates - girls.
  Coefficient .608; S.E. ± .063.
Fat indices and nutrition estimates - boys.
  Coefficient .586; S.E. ± .064.
Limb girth indices and nutrition estimates - girls.
  Coefficient .277; S.E. ± .092.
Limb girth indices and nutrition estimates - boys.
  Coefficient .269; S.E. ± .090.

It will be noted that the coefficients for the fat indices and nutrition estimates were almost as high as those for the weight indices, but that those for the limb girth indices and nutrition estimates were very low.

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[3] *McCloy gives 2 formulas for determining the fat index:*

1. $\frac{\text{Actual fat}}{\text{Normal fat}} \times 100$. *With this index the normal range is 90 to 120 inclusive.*
2. $\frac{\text{Actual fat minus normal fat}}{\text{Normal minus minimum}} \times 100$. *With this index the normal range is 67 to 166 inclusive.*

[4] *In adolescent girls, or those past adolescence, the fat over the trochanters is measured by determining the "hip difference". (See McCloy, 9, p. 123).*

[5] *McCloy (10, p. 52) also gives equations for the prediction of total normal trunk fat from body build measurements, but for general purposes recommends the use of averages for each age and sex.*

Comparison of McCloy and Baldwin-Wood Weight Standards

The second method used to study the validity of the determinations of normal weight was to compare the standard weights (according to both the McCloy and Baldwin-Wood standards) of pairs of children who were of the same sex and approximately the same height and age, but widely differing builds. An example of this type of comparison follows:

	Case 1	Case 2
Sex	F	F
Age	9.99	10.08
Height	52.3 in.	51.9 in.
Chest girth	54.8 cm.	62.4 cm.
Hip width	20.6 cm.	21.2 cm.
Knee width	7.5 cm.	8.3 cm.
Actual weight	49.8 lbs.	70.2 lbs.
Standard weight (McCloy)	57.5 lbs.	70.2 lbs.
Standard weight (Baldwin-Wood)	62.0 lbs.	62.0 lbs.
Per cent over or underweight according to McC.	-13.5	0.0
Per cent over or underweight according to B.-W.	-19.7	+13.2
Nutrition estimate	Poor	Good
Per cent over or under fat according to McC.	-42.0	- 1.4

It will be seen that these girls differed especially in chest circumference, yet by the Baldwin-Wood standards both should have weighed 62 pounds. This would have made Case 1 19.7 per cent underweight and Case 2 13.2 per cent overweight. Case 1 was definitely underweight but owing to her narrow skeleton she was not as much underweight as the Baldwin-Wood standard indicated. The McCloy standard, which was 4.5 pounds less than the Baldwin-Wood, therefore seems more correct for this girl. Case 2 appeared to weigh the right amount, so the McCloy standard again seems to be more correct.

Height and Weight Curves with Study of Weight Standards

The third method of study was to plot the height and weight curves of a number of children for the 4-year period during which they were weighed 8 times. Curves showing the McCloy and Baldwin-Wood standards were also plotted on each child's weight chart. These curves were of considerable value in studying the applicability of each standard to each individual case. Figure 1 gives the height and weight curves for Case 2, whose measurements at the time of her first examination are given above. The following facts can be noted by a study of this figure:

1. For this girl, whose skeleton was larger than the average, the McCloy standards apply much better than the Baldwin-Wood.

2. With rapid gains in weight, such as occurred between ages 11.1 and 11.7 and again between 12.1 and 12.7, the standards increase somewhat more than would be expected for the gains in weight. At ages 11.7 12.1 and 12.7 this girl is very slightly underweight by the McCloy standards, although she appeared to be overweight.

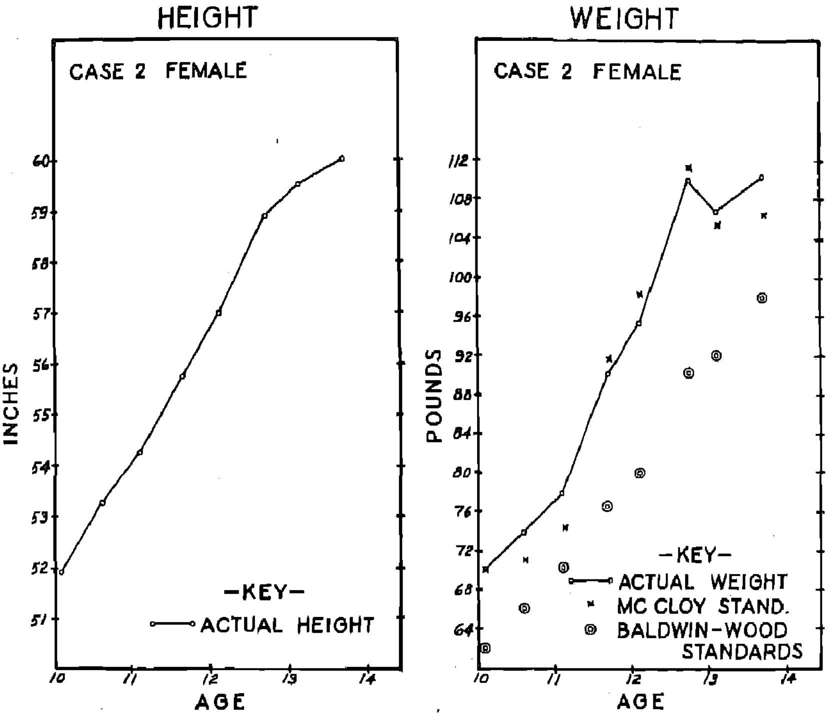

Figure 1. Height and weight curves for Case 2 showing McCloy and Baldwin-Wood weight standards.

3. With a weight loss of 3 pounds, such as occurred between ages 12.1 and 12.7 there is a corresponding decrease in the standard of 5.9 pounds.

McCloy Weight Standards for Subjects Gaining Weight or Overweight

Since the study of the McCloy weight standards for Case 2 (Figure 1) seems to indicate that with a rapid increase in weight there is a tendency for the standards to increase more than would be expected, a study was made of the weight and fat indices of 43 grade-school children and 68 college girls who were judged by the writer to be "slightly overweight" or "overweight".[6] Table 1 gives the distribution of subjects according to their weight indices $(\frac{\text{actual weight}}{\text{normal weight}} \times 100)$. It will be seen that among the "slightly overweight" subjects 100.0 per cent of the grade-school girls, 44.4 per cent of the grade-school boys, and 73.8 per cent of the college girls had weight indices which McCloy considers within the normal range (96.00-107.99). Among the "overweight" subjects 73.3 per cent of the girls, 40.0 per cent of the boys, and 42.3 per cent of the college girls also had weight indices within the normal range.

[6] *The entire group examined included 564 girls, 555 boys, and 263 college girls.*

TABLE 1

DISTRIBUTION OF McCLOY WEIGHT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS JUDGED AS "SLIGHTLY OVERWEIGHT" OR "OVERWEIGHT"

Weight Index	Nutrition Estimates					
	Slightly Overweight			Overweight		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
122.00-123.99			1			
120.00-121.99						
118.00-119.99					1	1
116.00-117.99						1
114.00-115.99			1			2
112.00-113.99			1	1	2	5
110.00-111.99		3	6	2	1	2
108.00-109.99		2(55.6%)	1(23.8%)	1(26.7%)	2(60.0%)	4(57.7%)
106.00-107.99		2	5	2	1	3
104.00-105.99	2	2	6	1	1	1
102.00-103.99	2		7			5
100.00-101.99	2		6	2	1	1
98.00- 99.99	1		7	4	1	
96.00- 97.99	2(100.0%)	(44.4%)	(73.8%)	2(73.3%)	(40.0%)	1(42.3%)
94.00- 95.99			1(2.4%)			
Totals	9	9	42	15	10	26
% of total no. examined	1.6	1.6	16.0	2.7	1.8	9.9

TABLE 2

DISTRIBUTION OF McCLOY FAT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS JUDGED AS "SLIGHTLY OVERWEIGHT" OR "OVERWEIGHT"

Fat Index	Nutrition Estimates					
	Slightly Overweight			Overweight		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
200.00-204.99					1	
195.00-199.99						
190.00-194.99						
185.00-189.99					1	
180.00-184.99				1	1	
175.00-179.99				1		1
170.00-174.99						
165.00-169.99		1	1		2	
160.00-164.99			2			2
155.00-159.99				2		1
150.00-154.99		1	1	1	2	2
145.00-149.99		2	2	1		3
140.00-144.99		1	3	1		2
135.00-139.99	2	2			1	3
130.00-134.99			4			7
125.00-129.99		2	5			3
120.00-124.99			4			1
115.00-119.99	1		4	1		
110.00-114.99	1(44.4%)	(9.0%)	9(83.3%)	1(60.0%)	1(90.0%)	1(100.0%)
105.00-109.99	2		4	2	1	
100.00-104.99	1		1	1		
95.00- 99.99	(33.3%)		1(14.3%)	2(33.3%)	(10.0%)	
90.00- 94.99			1	1		
85.00- 89.99	2(22.2%)		(2.4%)	(6.7%)		
Totals	9	9	42	15	10	26

Table 2 gives the distribution of the same subjects according to their fat indices $(\frac{\text{actual fat}}{\text{normal fat}} \times 100)$. Of the "slightly overweight" grade-school girls, 33.3 per cent had fat indices between 95.00 and 109.99 (a range chosen by the writer to correspond more closely with the normal weight range than the 90-120 used by McCloy). None of the "slightly overweight" boys and only 14.3 per cent of the "slightly overweight" college girls had indices within this range. Among the "overweight" subjects 33.3 per cent of the girls, 10.0 per cent of the boys, and none of the college girls had fat indices within the chosen normal range.

To summarize the data given in Tables 1 and 2: while 63.1 per cent of the "slightly overweight" and "overweight" subjects had weight indices within the normal range (96.00-107.99), only 13.5 per cent had fat indices within the chosen normal range (95.00-109.00). Therefore, even allowing for some probable errors in the judgment of overweight (as in the case of the grade-school girls) and for the possibility that some of the subjects who appeared to be overweight were merely overfat and poor in muscular development, it appears that the McCloy weight standards for overweight subjects are somewhat high, thus giving low weight indices.

Position of Weight Standards for Fat Children on Wetzel Grid Charts

In connection with the above discussion of weight standards for fat children it may be stated that the McCloy normal weights[7] (and actual heights) for the subjects judged as "slightly overweight" or "overweight" were plotted on the Wetzel (12) grid charts.[8] For 28 of the subjects the points fell in channel A_4, which is used by Wetzel to classify children as obese. Although some of the 28 had large frames, it does not seem possible that all of them had skeletons large enough to place them normally in channel A_4, instead of A_3 or A_2 which Wetzel uses to classify children as stocky.

McCloy Weight Standards for Subjects Losing Weight or Underweight

A study of the McCloy weight standards for Case 2 (Figure 1) also shows that with a weight loss there is a decrease in the weight standard. Since a child's skeleton would not decrease in size, no matter what the weight loss, it appears that this decrease must be due to an inadequacy in the method of determining the standard.

In order to determine the frequency with which a decrease in the weight standard occurred when there was a weight loss, a study was made of all of the changes in the standard which accompanied weight losses during a 6-month period. During the 4-year study of the Newport children there were 28 instances of weight loss, 9 of which were accompanied by a decrease in the McCloy weight standard. It should be stated, however, that in most cases this decrease was very slight (average 1.3 lbs.).

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[7] *Instead of the actual weights.*

[8] *These charts have been published for use in following a child's progress in growth and for determining his body build, developmental level, and basal metabolism. Information to be secured from the grid is all obtained from measurements of height and weight alone. Wetzel apparently proposes that the physician's judgment be relied on to determine whether or not the child is developing along the correct channel, as indicated on the grid chart.*

Since the McCloy weight standards show this tendency to decrease when there is a weight loss, a study was made of the weight and fat indices of the 237 grade-school children and 65 college girls who were judged by the writer to have fair or poor nutrition. Table 3 gives the distribution of these subjects according to their weight indices. It will be seen that among the subjects judged "fair", 11.0 per cent of the grade-school girls, 33.0 per cent of the boys, and 30.2 per cent of the college girls had normal weight indices. Of the subjects judged "poor" 3.1 per cent of the grade-school girls and 37.5 per cent of the boys had normal indices. It should be stated, however, that some of the children were rated "fair" or "poor" on account of defects other than apparent underweight and thus were among those with normal weight indices.

TABLE 3

DISTRIBUTION OF McCLOY WEIGHT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS ESTIMATED AS HAVING FAIR AND POOR NUTRITION

Weight Index	Nutrition Estimates					
	Fair			Poor		
	Girls	Boys	Col. Girls	Girls	Boys	Col.Girls
108.00-109.99			1(1.6%)		1(12.5%)	
106.00-107.99						
104.00-105.99		1	1			
102.00-103.99		1	1		1	
100.00-101.99	2	7	3		1	
98.00- 99.99	2	10	6			
96.00- 97.99	6(11.0%)	16(33.0%)	8(30.2%)	1(3.1%)	1(37.5%)	
94.00- 95.99	10	18	7	2	1	
92.00- 93.99	18	26	21	1	1	
90.00- 91.99	17	16	8	3	2	
88.00- 89.99	9	8	5	7		1
86.00- 87.99	19	3	1	5		
84.00- 85.99	4			3		1
82.00- 83.99	2		1	3		
80.00- 81.99	1			2		
78.00- 79.99	1			1		
76.00- 77.99				3		
74.00- 75.99	(89.0%)	(67.0%)	(68.2%)	1(96.9%)	(50.0%)	(100.0%)
Totals	91	106	63	32	8	2
% of total no. examined	16.1	19.1	24.0	5.7	1.4	.8

Table 4 gives the distribution of subjects according to their fat indices. Of those rated "fair", 5.5 per cent of the girls, 7.5 per cent of the boys, and 12.7 per cent of the college girls had fat indices within the normal range chosen by the writer (95.00-109.99).

To summarize the data given in Tables 3 and 4: while 22.5 per cent of the subjects judged "fair" or "poor" had normal weight indices, only 7 per cent had fat indices within the chosen normal range. It therefore appears that the McCloy weight standards for underweight subjects are somewhat low, giving high weight indices.

TABLE 4

DISTRIBUTION OF McCLOY FAT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS ESTIMATED AS HAVING FAIR AND POOR NUTRITION

Fat Index	Nutrition Estimates					
	Fair			Poor		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
145.00-149.99			1			
140.00-144.99						
135.00-139.99						
130.00-134.99						
125.00-129.99						
120.00-124.99						
115.00-119.99						
110.00-114.99			1(3.2%)			
105.00-109.99		1	2			
100.00-104.99	1	2	1			
95.00- 99.99	4(5.5%)	5(7.5%)	5(12.7%)			
90.00- 94.99	2	20	11		1	
85.00- 89.99	7	22	11		2	
80.00- 84.99	18	25	10	3	3	
75.00- 79.99	28	26	13	5	1	1
70.00- 74.99	22	5	4	5	1	1
65.00- 69.99	9		3	11		
60.00- 64.99			1	6		
55.00- 59.99	(94.5%)	(92.5%)	(84.1%)	2(100.0%)	(100.0%)	(100.0%)
Totals	91	106	63	32	8	2

Possible Explanations for Increases and Decreases in Weight Standards

The above mentioned increases in weight standards which may accompany increases in fat, and decreases which may accompany decreases in fat, can be partly explained as due to the fact that the McCloy method does not always allow for accurate correction of the chest circumference measurements for fat. In individuals gaining in fat there is an increase not only in the subcutaneous fat which can be measured with the fat calipers, but also in the fat of the deeper muscle tissues, which cannot be measured. The chest circumference measurement is corrected only for subcutaneous fat and the use of too high a chest circumference gives too high a standard weight. A slight error is also introduced by using a knee width which is uncorrected for fat.

The opposite situation exists in the case of a child who is losing weight. Fat is lost[9] in both superficial and deep tissues, but correction is made only for the subcutaneous fat which can be measured with the fat calipers. This gives too low a chest circumference and too low a weight standard.

As suggested by Dr. McCloy, another factor which may cause errors in fat measurements is the fact that when a thick layer of fat is being measured there is high tension on the spring in the subcutaneous tissue calipers. This tends to give too low a fat measurement, which results in too high a corrected chest circumference and too high a weight standard. In the measurement of a very thin layer of fat the opposite situation may exist. Less tension on the spring tends to give too high a fat measurement, which results in too low a corrected chest circumference and too low a weight standard.

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[9] *In extreme cases of weight loss muscle may also decrease. This would also influence the chest circumference measurement to some extent.*

Comparison of McCloy and Pryor Weight Standards

The above mentioned inaccuracies of the McCloy weight standards for markedly overfat and emaciated individuals made it seem desirable to compare the McCloy and Pryor standards on a group of identical subjects. The necessary measurements had been taken by the writer on the previously mentioned group of 263 college freshman girls. Table 5 gives the results of this comparison. It will be noted that in the majority of cases the McCloy standards were lower than the Pryor. Also, it was found that when the McCloy standards were lower the average deviation between standards was 6.45 as against 3.27 when the Pryor standards were lower. For markedly underweight subjects the higher Pryor standards would probably be more nearly correct but in the slightly underweight, normal, and overweight groups the lower McCloy standards would seem to be more adequate.

TABLE 5

DISTRIBUTION OF McCLOY WEIGHT INDICES OF COLLEGE FRESHMAN GIRLS ACCORDING TO RESULTS OF A COMPARISON OF McCLOY AND PRYOR STANDARD WEIGHTS

Weight Index	McCloy Weight Higher	McCloy Weight Lower
115.01 and above (overweight)	0	3
108.00-115.00 (sl. overweight)	9	22
96.01-107.99 (normal)	49	100
96.00-94.00 (sl. underweight)	7	14
93.99 and below (underweight)	15	44
Totals	80	183

Value of McCloy Method

In the writer's opinion the McCloy method for determining normal weight warrants the time required to make the necessary measurements and calculations, since the standards are apparently more reliable than any at present available. It may be said, however, that the low correlation obtained between limb girth indices and nutrition estimates, indicates that this index is not of sufficient value to warrant the expenditure of time required to secure it. In the majority of individuals the determination of the weight and fat indices provides the information necessary to determine whether or not there is a normal distribution of muscle and fat. The omission of the limb girth measurements would also simplify the procedure of taking the measurements, since children would not have to wear a one piece examining gown. With the omission of the thigh girth measurement, both girls and boys could wear trunks with an elastic top which could be slipped down over the hips. In addition, girls could wear a short cape around the shoulders.

Following are the measurements necessary for determining the weight and fat indices: standing height, weight, chest circumference at xiphoid level, bi-iliac hip width, knee width, fat-chest front, fat-chest back, fat-suprailiac, and fat-abdominal. The taking of these measurements requires about 8 minutes and about the same length of time is needed to make the necessary calculations of the two indices for each subject.

SUMMARY

The use of the McCloy method for the determination of normal weight in a 4-year study of grade-school children and in a group of college freshman girls has shown that the method gives results which appear reasonably accurate except in markedly overfat or emaciated individuals.[10]

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[10] *McCloy uses age at the last birthday. This is not stated in his publications.*

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AN ACOUSTICAL STUDY OF THE PITCH OF INFANT HUNGER WAILS

GRANT FAIRBANKS[1]

This paper reports an acoustical investigation of the pitch of experimentally induced hunger wails[2] produced by the author's male infant. In brief, the experimental situation was this: On the consecutive monthly birth dates for the first 9 months of life the regular 2 o'clock afternoon feeding period was withheld, the infant was brought into the recording laboratory and placed before the microphone. After wailing vocalization was approximately continuous, a condition which was reached between 15 minutes and 1½ hours after placement before the microphone, a 4 minute phonograph recording was cut. This recording was subjected to acoustical measurement.

The characteristics of the infant show him to have been a suitable subject for this type of experimentation. The delivery was full-term, normal and easy. The birth weight was 7½ pounds, which is approximately average for male infants in the Middlewest. According to a periodic series of anthropometric and psychological measurements made by the Child Welfare Research Station and the Department of Pediatrics at the State University of Iowa, which measurements will not be presented in detail, the infant grew and developed within the average range. He was breastfed, had no digestive disturbances, and, in fact, no illnesses of any kind during the entire 9-months period of measurement. Of especial pertinence to this study is the fact that he rarely cried, and, in general, gave every superficial evidence of being an unusually comfortable and happy infant. It should be emphasized that on none of the 9 recording occasions was he wailing at the time of being brought into the laboratory.

Acoustical analysis of the pitch of the recorded hunger wails was accomplished by means of an instrument for phonophotography and fundamental frequency measurement from phonograph recordings, most recently described by Cowan (2). The over-all error of this method of frequency measurement is approximately 0.5 per cent, or 0.04 tone. Within each 4-minute recording, 6 equally spaced, 10-second intervals were photographed, supplying for measurement, thus, 60 seconds from each recording, a total of approximately 9 minutes for the entire period.[3]

I. RESULTS

Figure 1 presents graphs of frequency distributions of the pitches used. These are similar to conventional frequency polygons, except that

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[1] *From the Department of Speech, State University of Iowa.*

[2] *No brief is held for the description of the vocalizations as "hunger wails," nor does it seem to be fruitful to speculate about the degree to which they reflected fear, anger, or any other affective state. The term is used to refer conveniently to the crying which occurred under the conditions described.*

[3] *The process of measurement is laborious, and, if these samples appear to be small, it may be mentioned that past studies of speech have customarily measured intervals of from 4 to 30 seconds in duration. As a matter of fact, the data reported above involved the individual consideration of more than 170,000 sound waves.*

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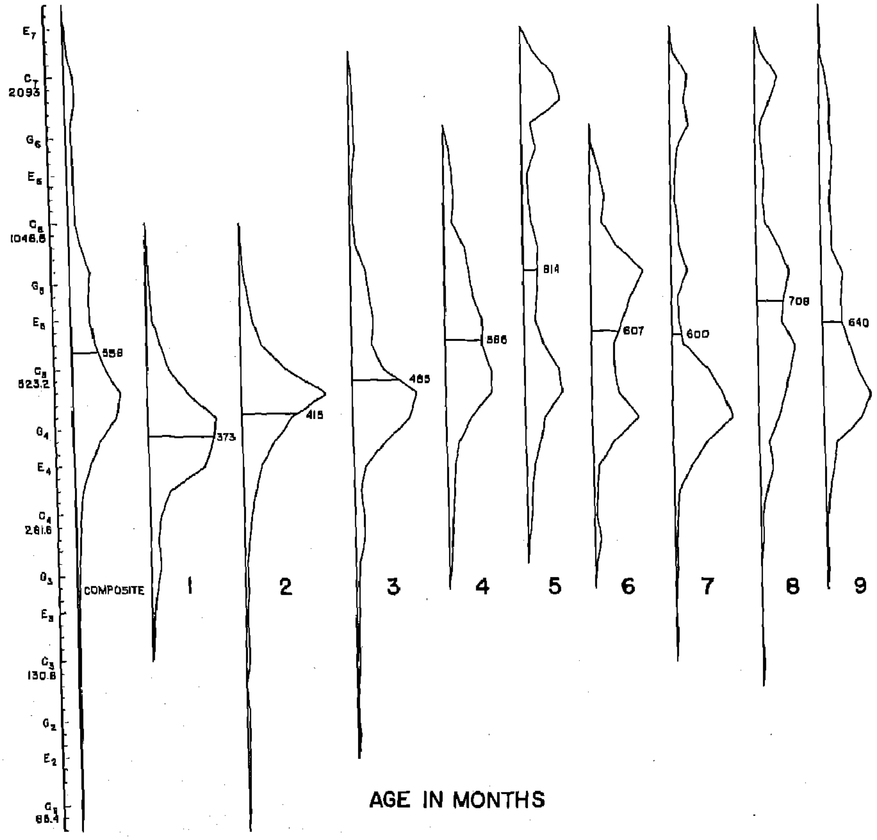

Figure 1. Frequency distributions of the pitches used.

the variable being measured is shown along the vertical axis which is the equal-tempered musical scale. The abscissa, in the case of each distribution, is percentage of cases, making the distributions mutually comparable as to shape. The means are indicated by horizontal lines. A composite distribution of all pitches measured during the entire 9-months period is shown at the left, while distributions for the consecutive monthly measurements comprise the balance of the figure. In Table 1 are presented the data computed from the distributions.

The major results of the study, which may be observed in Figure 1 and Table 1, fall into two divisions; 1) the general pitch characteristics of the wails; 2) changes in these characteristics during the time interval considered.

General Pitch Characteristics of the Hunger Wails

The mean of the composite distribution is seen to be 556 cycles per second. This is more than one octave higher than the central tendency of the average adult female speaking voice, and more than two octaves

TABLE 1

MEASUREMENTS OF FREQUENCY AND PITCH

	Composite	Age in Months								
		1	2	3	4	5	6	7	8	9
Mean (∿)	556	373	415	485	585	814	607	600	708	640
Lowest Frequency (∿)	63	153	63	89	214	229	206	150	134	207
Highest Frequency (∿)	2631	888	947	2120	1495	2387	1487	2348	2329	2631
Mean (tones + 16.35∿)	30.7	27.3	28.2	29.5	31.2	34.0	31.5	31.4	32.8	31.9
S. D. (tones)	4.6	2.3	3.1	3.7	3.3	5.7	3.3	5.5	4.7	4.3
Total Range (tones)	32.6	15.3	23.5	27.5	16.9	20.4	17.2	23.9	24.9	22.3
90% Range (tones)	15.8	8.2	9.0	12.2	11.3	16.1	10.3	15.8	16.0	14.0

higher than that of the average adult male.

The lowest frequency measured during the entire period was 63 c.p.s., approximately two octaves below middle C. Values this low are reasonably common in average adult male speech, and it is not unusual for concert basses to sustain such tones. In fact, some choral basses are reported to be capable of singing tones one octave lower. It is somewhat surprising, however, to discover frequencies of this order produced by an immature infant larynx. It should be pointed out that this is not one isolated measurement, but that the distribution is more or less continuous from the mean down (see Figure 1).

At the upper end of the distribution the highest frequency measured was 2631 c.p.s. This tone is approximately one octave higher than the top notes sung by such a coloratura soprano as Lily Pons in the Bell Song, the Quartet from Rigoletto, etc. Very few singers have been reported to be capable of singing tones of the frequency measured, more than 3 octaves above middle C.

These extreme values, encompassing, as has been shown, the lowest notes of the bass and the highest notes of the coloratura, provide a total range during the period of 32.6 musical tones, or somewhat in excess of 5 octaves. This may be compared to the maximum singing range of the adult, usually found to be in the neighborhood of 18 to 20 tones, or approximately 3 octaves, on the average.

Changes in the Pitch Characteristics of the Hunger Wails

Inspection of the monthly means in Figure 1 and Table 1 shows that there is a rapid and consistent rise throughout the first half of the period, followed by irregular but smaller changes thereafter, which form what might be termed a plateau at this higher level. It will be noted that these changes in central tendency cover the wide range of 6.7 tones, or more than one octave. The shape of the distributions is also seen to change. From a comparatively normal distribution at one month, the variability is seen to increase and the distributions to become more irregular. Again this change is rapid throughout the first half of the period. Attention should be called to the rather prominent secondary peaks to be seen at the upper ends of the distributions during the last part of the period.

In order to assist visualization of the changes, four of the measures from Table 1 are graphed in Figure 2. The top curve of variations in the mean pitch level shows the positively accelerated rise followed by the plateau, features which have been described above. The second curve, that of the total pitch range, is seen to vary somewhat sporadically. Because this unreliable measure of variability is affected by a few isolated cases, the data plotted in the third curve were computed. This measure, which has been termed the "90 per cent pitch range," is, for any given sample, the range of pitch which subtends the median 90 per cent of the cases. In other words, it is the difference between the ninety-fifth and the fifth percentiles of the frequency distribution. The variations in this measure are seen to be more regular, and to be not dissimilar to the variations of the mean. The changes in the standard deviation, shown in the fourth curve, are observed to correspond even more closely to the variations of the mean.

In summary, the changes during the first 9 months were found to consist of 1) a large and rapid rise in the central tendency of the pitches used during the first half of the period, followed by a more or less consistently high level thereafter; 2) concomitant changes in pitch variability.

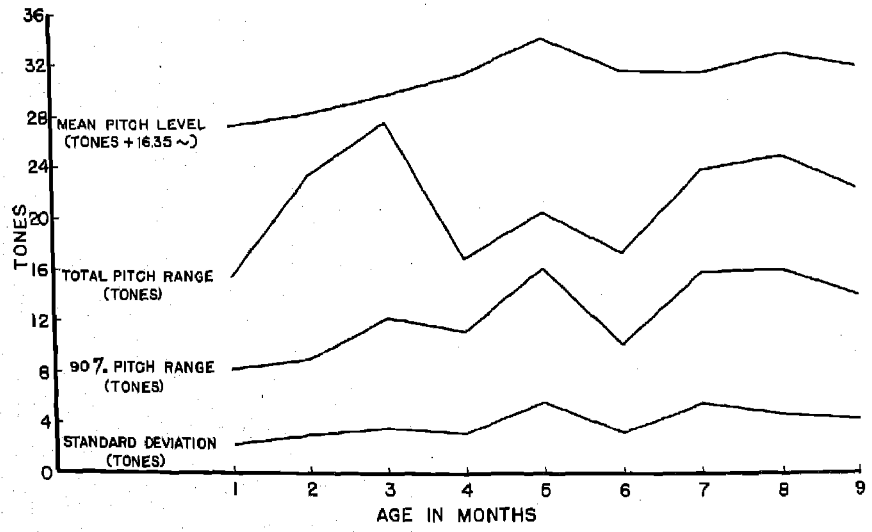

Figure 2. Variations in pitch characteristics during the nine-months period. A: Mean pitch level in tones above 16.35 c.p.s. B: Total pitch range in tones. C: 90 per cent pitch range in tones. D: Standard deviation in tones.

II. DISCUSSION

The available data afford no basis for the restrictive selection of any single factor, or group of factors, as responsible for these changes in the hunger wails. It is known that the growth of the larynx during the first year of life is normally very rapid, probably more rapid than during any other post-natal year, with the possible exception of the fifteenth in the male. There is no reason to believe that the subject of the present study is markedly different from the average infant in this respect. Presumably a feature of the laryngeal growth is an increase in the length and thickness of the vocal folds, a change which accompanies normal pre-adult growth. Differences in these respects also distinguish male from female larynges and are the major factors in the vocal pitch differences between the sexes. Since, other variables constant, increases in length and thickness lower the natural frequency of a vibrator, a progressive lowering of the pitch level, as in the case of the change from childhood to maturity, might be expected. Instead, as has been shown above, the change in the central tendency of the hunger wails was generally upward during the first half of the period. In other words, the direction of the observed change in pitch level was inconsistent with the presumed change in length and thickness of the vocal folds. As has been suggested, length and thickness probably determined, or at least limited, the general pitch level of the entire period; since presumably they changed rapidly, their influence may not be overlooked in an explanation of the vocal changes during the period. However, in view of this inconsistency, it seems reasonable to conclude, by elimination, that the observed change in pitch level was primarily a function of variation in vocal fold tension rather than of variation in length and thickness.

If this analysis be accepted, then a progressive increase in the tension of the laryngeal musculature during the first half of the period may be inferred and requires explanation. This increase might be related to certain psychological conditions. Such conditions constant, however, it might reflect simply an increase in the capacity to exert muscular tension in and adjacent to the larynx. This suggestion would be consistent with the fact that the average infant undergoes very rapid neuro-muscular development during the first half year of life, and it would provide an explanation for the rise in pitch during the first 5 months. It is not necessarily incompatible with the approximate plateau during the balance of the 9-months period. The latter might be interpreted to result from marked negative acceleration of neuro-muscular development (which is believed to occur at about that age) coincident with less negatively accelerated continuation of dimensional growth. In a like manner the changes in pitch variability may be explained.

Nevertheless, it would be difficult to defend an exclusively growth-and-development interpretation. It may have been observed that the curves depicting the pitch changes are remarkably similar to previous plottings of data secured during the establishment of conditioned responses. This similarity does not prove, *per se*, that a process of conditioning or learning was going on. In the light of what is known of infant behavior, however, it is not unreasonable to suggest this as a possibility. One measure of the goodness of conditioning is the magnitude, amplitude or vigor of the response. Anrep (1), for example, measured the amount of salivary flow per unit of time, while Hilgard and Marquis (4) and Hilgard and Campbell (3) recorded the amplitude of reflex eyelid movement. The measurements made in the present study may be considered comparable in the field of vocal response.[4] Making allowance for variations in drive (e.g., hunger), and for the fact that one subject only was studied, the changes in vocal pitch are such as would be predicted on a conditioning or learning hypothesis. It may be added that conditioning phenomena, if present, do not, of course, preclude such concurrent operation of other variables as has been discussed above.

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[4] *Vocal intensity might have been an even better measure of the vigor of a vocal response, but the available recording equipment was incapable of handling the extreme intensity range.*

THE EFFECT OF SOCIAL GROUPINGS UPON THE LANGUAGE OF PRESCHOOL CHILDREN[1]

RUTH M. WILLIAMS AND MARION L. MATTSON

Children's language development has been studied from many angles but there has been little work done on the important factor of the relationship between children's verbal responses and the number of child and adult companions. Since language is primarily a response to a social situation, is intended to convey meaning to some other person, the presence of other people in the environment would seem to have an influence upon the quantity and maturity of language activity.

This study is an attempt to determine what is the effect of increasing the size of the play group of nursery school children upon their language.

PREVIOUS INVESTIGATIONS

In order to study the social behavior of children which is expressed by language, various experimental methods have been worked out. Piaget (7) made an intensive study of the language of two children under ordinary home conditions where there was no attempt to control the situation. The language records of these children were classified according to different types of social and egocentric speech. McCarthy (5) recorded 50 verbal responses for each of 140 children when they were exposed to the same play materials in an experimental situation. In this study a modified form of Piaget's classification was used.

Fisher (2) analyzed stenographic records of large samples of language expression of 72 children in a natural nursery school situation. When acceptably high reliability on the Piaget classification could not be obtained, a special classification was worked out by dividing language into the four following categories: self as the subject, other person as the subject, a thing as a subject, and non-verbal language. Fisher found that the use of structurally complete sentences increased rapidly up to the beginning of the fourth year, thereafter the ratio of complete and incomplete sentences remained constant.

Studies have been made in which all-day conversations were analyzed according to parts of speech. Investigators generally agree that there is a marked decrease in the percentage of nouns and a corresponding increase in percentage of verbs during the preschool years. Verbs increase from 14 to 25 per cent; adjectives almost double; adverbs show no consistent tendency with age never exceeding 9 per cent. Pronouns gain from 10 to 20 per cent up to the age of 30 months and then remain constant. Prepositions and conjunctions appear late and do not form an important part of the child's vocabulary (6).

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[1] *The study was made in partial fulfillment for the requirements of a Master's degree at Purdue University, Lafayette, Indiana. The work was directed by Dr. Mattson.*

METHODS

Subjects

Subjects were 6 children attending the nursery school at Purdue University. The group consisted of 3 boys and 3 girls, who ranged in age at the beginning of the experiment from 43 to 46 months and with I. Q.'s from 104 to 116 on the Minnesota Preschool Scale. These children had all been in nursery school the previous year so were familiar with the environment and each other. They were accustomed to being invited into the experimental room to "play games", a procedure to which they usually looked forward with eagerness.

Recording Machine

Ten minute language records were secured by means of a Fonda Recorder[2] which transcribed upon acetate tape all verbal responses that occurred within the room. It was thus possible to obtain an accurate record of the language responses of the entire group of subjects at the same time.[3]

Experimental Set-up

An experimental play situation was set up in a small room adjoining the nursery school. This was equipped with a low table and chairs and a cabinet containing such toys as a small doll family, rubber animals and trucks, blocks, pencils and pads, toy telephone and picture books. It was felt that such a wide range of play materials would hold interest for each child. There were also pictures on the wall and a bowl of goldfish. The recorder was placed behind a screen in such a way that it could be operated by the experimenter but was not visible to the subjects.

Each child had a turn to play freely with these materials alone, alone with the experimenter, and in a group composed of one other child and the experimenter, and also in a group composed of two other children and the experimenter. As all possible combinations of children were utilized each child was in the play situation for 17 different 10 minute periods. In all, there were 47 ten minute language records, or a total of 470 minutes of language records.

ANALYSIS OF LANGUAGE RESPONSES

The language responses were transcribed on paper and arranged into sentences, a natural pause on the record indicating what constituted a sentence. The language responses were then analyzed according to the four following classifications: type of sentence, parts of speech, social usage, and a modification of Piaget's functional analysis.

Analysis I - Type of Sentence

1. For this study, a complete sentence was defined as any sentence which has a complete meaning for the child. It may be structurally incomplete.

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[2] *Manufactured by the Fonda Corporation, New York City. This was an experimental design and is not in commercial production.*

[3] *In order to check the accuracy of the record transcribed from the acetate film the investigator, after an interval of 3 months, again transcribed all of the records of a single child in the study and found a 93 per cent agreement with her first record for that child.*

2. Each sentence was classified either as a complete sentence or an incomplete sentence. At the same time, the number of words in the sentence was counted.
3. Contractions were considered as one word.
4. Dashes indicated pauses.
5. Names of people, such as John Smith, were one word.
6. Hyphenated words were one word.
7. Infinitives and participles were counted as one word.

Analysis II - Parts of Speech

The definitions for the parts of speech were taken from a standard English text book (1).

Analysis III - Social Usage

1. Parallel speech: A child talks to himself when someone else is in the room. When a child telephones to someone else outside the room, it is a parallel speech.
2. Social speech: One child talks to another, exchanging ideas, asks a question and either gets or receives an answer, etc. When a child talks on a telephone to someone in the room, it is social speech.
3. Monologue: One child talks to himself as if thinking out loud. No one else is in the room.
4. Each sentence was classified as parallel speech, social speech, or monologue.
5. Each sentence received only one classification.

Analysis IV - Piaget's Analysis

A. Socialized Speech
   1. Friendly intercourse is an exchange of thought or ideas of two or more people. It is a friendly conversation directed to someone or giving out information for the benefit of someone.
   2. Criticism includes all remarks about the behavior of a thing or person.
   3. Commands, request, and threats are all wishful words.
   4. Questions are any remarks that definitely require an answer from the hearer.
   5. Answers are all answers to real questions or commands.

B. Ego-centric Speech.
   1. Repetition is the repetition of words or syllables for the pleasure of talking; with no thought given of talking to anyone.
   2. Monologue occurs when a child talks to himself as though thinking out loud.
   3. Dual or collective monologue occurs when an outsider is associated with the action or thought of the moment, but is expected neither to hear nor to understand what is said (7).

RELIABILITY

Reliability of Scoring

To test the reliability of the scoring of the various categories into which language responses were divided, 6 persons, all members of the Nursery School staff, rated one-tenth of the records after a brief practice period. The transcribed sentences were analyzed individually by each one of the raters who followed the same directions that the experimenter had used.

The scores of the 6 judges were arranged in rank order and, by use of the Spearman rank method, each rater's score was correlated with that of every other rater.

As shown by Table 1, there was a wide range of reliability coefficients, but for the most part they were high. The categories of parallel speech under Social Usage, and adjectives and articles under Parts of Speech showed a definite need for a longer or more thorough practice period for the judges or a more rigid definition of the terms. Of the 33 medians of coefficients 27 were 1.00 and only 4 fell below +.85.

Fisher's study (2) rejected the classifications of dual monologue and monologue in Piaget's analysis because her judges were so unreliable. Median correlation of the judges of the present study range from +.90 to +1.00 which seems sufficiently high to permit the use of Piaget's intensive interpretation.

RESULTS

Tables 2 and 2-A are based on records for the ten minute periods regardless of whether or not conversation occurred. The following tables consider only the instances in which conversation took place.

In evaluating these tables it should be pointed out that percentages in column (D) were somewhat lowered because two of the children did not talk at all during 4 of 20 ten minute periods. In all other periods in this study, every child spoke at least a few words.

Analysis I - Type of Sentences

From an examination of Table 2 one can see that the largest average number of sentences, 30.53, occurred when two children were in the experimental room with the observer. We find that the highest average number of words in a sentence, 4.18, also occurred when two children and an observer were together. The average number of words per sentence remains almost constant as the size of the group is increased and is in substantial agreement with other studies. Smith (9) found an average of four words per sentence at the age of 3½ years; while Strang (10) reports an average of three and seven-tenths words at the same age.

The greatest amount of talking occurred when there were one or two children in the room at the same time. While the differences are not great, the analysis reveals a slight tendency for the group of two subjects and an adult to be more talkative. In this combination it is interesting to note that every child talked some; whereas in the largest group, 36 per cent of the time respectively, a child did not talk at all.

TABLE 1

MEDIAN AND RANGE OF RELIABILITY COEFFICIENTS OF THE SIX JUDGES ON EACH TYPE OF CLASSIFICATION

Classification	Median	Range
Type of Sentence		
Complete sentence	+ 1.00	+ 1.00 to + 1.00
Incomplete sentence	+ .85	+ .85 to + 1.00
Number of Words in a Sentence		
One word	+ 1.00	+ 1.00 to + 1.00
Two words	+ 1.00	+ 1.00 to + 1.00
Three words	+ 1.00	+ .10 to + 1.00
Four words	+ 1.00	+ 1.00 to + 1.00
Five words	+ 1.00	+ 1.00 to + 1.00
Six words	+ 1.00	+ 1.00 to + 1.00
Seven words	+ .60	+ .60 to + 1.00
Eight words	+ 1.00	+ 1.00 to + 1.00
Nine words	+ 1.00	+ 1.00 to + 1.00
Twenty-five words	+ 1.00	+ 1.00 to + 1.00
Parts of Speech		
Noun	+ 1.00	+ 1.00 to + 1.00
Pronoun	+ 1.00	+ 1.00 to + 1.00
Verb	+ 1.00	+ .90 to + 1.00
Adverb	+ 1.00	+ 1.00 to + 1.00
Adjective	+ .60	+ .10 to + 1.00
Conjunction	+ 1.00	+ 1.00 to + 1.00
Article	+ .40	+ .40 to + 1.00
Interjection	+ 1.00	+ .60 to + 1.00
Preposition	+ .90	+ .90 to + 1.00
Play word	+ 1.00	+ 1.00 to + 1.00
Social Usage		
Monologue	+ 1.00	+ 1.00 to + 1.00
Parallel speech	+ .60	+ .60 to + 1.00
Social speech	+ 1.00	+ 1.00 to + 1.00
Piaget's Interpretation		
Friendly intercourse	+ 1.00	+ .90 to + 1.00
Criticism	+ 1.00	+ 1.00 to + 1.00
Command	+ 1.00	+ 1.00 to + 1.00
Questions	+ 1.00	+ 1.00 to + 1.00
Answers	+ 1.00	+ .60 to + 1.00
Repetition	+ 1.00	+ 1.00 to + 1.00
Monologue	+ 1.00	+ .90 to + 1.00
Dual Monologue	+ 1.00	+ 1.00 to + 1.00

TABLE 2

TYPE OF SENTENCE

(A)	Alone with Experimenter (B)	Two Children and Experimenter (C)	Three Children and Experimenter (D)
Total number of children participating	6	6	6
Number of situations	6	15	20
Average number of words for the ten minute period per child	126	127	116
Average number of words per sentence	4.07	4.18	3.99
Average number of complete sentences	28.66	29.87	22.78
Average number of incomplete sentences	.16	.35	.21
Average total number of sentences	28.82	30.53	22.99

TABLE 2A

STATISTICAL SIGNIFICANCE OF ANALYSIS OF TYPE OF SENTENCE

	B-C		B-D		C-D	
	t	per cent	t	per cent	t	per cent
Average No. of words for the ten minute period per child	4.01	1	3.35	2	2.54	5
Average No. of words per Sentence	.130	90-100	.115	90-100	.126	90-100
Average No. of Complete Sentences	3.34	2	3.56	1-2	2.43	5-10
Average No. of Incomplete Sentences	.128	90-100	.131	90-100	.131	90-100
Average Total No. of Sentences	3.32	2	3.34	2	2.00	10

The average number of words per child for the ten minute period was almost constant 116, 126, and 127, in the three situations.

In an effort to determine whether the differences of the means of the various sized groups were significant, the "t" statistics (4) were calculated for each difference. Results as large as those that appear in the accompanying tables occur by chance only the percentage of the time indicated in the various columns. From observing Table 2A, we notice that the "t" scores under "average number of words per sentence" and "average number of incomplete sentences" are not reliable but that the results of the other categories are highly reliable.

Analysis II - Parts of Speech

This study agrees with previous studies in the frequency of the different parts of speech used. Nouns and pronouns when added together were most frequent, verbs came next, adverbs and adjectives followed. The other parts of speech were of minor importance in the vocabulary of this group of children 3¼ years old. Percentages of the various parts of speech remained relatively constant regardless of the size of the group except in the case of adjectives which decreased and adverbs which increased as the size of the group increased. Apparently children of this age describe action more than things as the size of the group increases. The averages for the remaining parts of speech seem to be quite consistent for the various sized groups. Play words such as "gee, gee", "boobe", and "pooly wooly" tend to decrease in frequency as the size increased.

Low percentages based upon "t" scores in Table 3A indicate that in general, differences found between parts of speech in different social groups are true differences not due to chance. Twenty-four of the 30 differences would occur by chance from one to ten times in a hundred.

TABLE 3

PARTS OF SPEECH

(A)	Alone with Experimenter 6 situations (B)	Two Children and Experimenter 15 Situations (C)	Three Children and Experimenter 20 Situations (D)
		Percentages	
Pronouns	20.78	20.26	18.99
Nouns	8.97	9.92	13.99
Total of Nouns and Pronouns	29.75	30.18	32.98
Verbs	28.73	27.93	27.23
Adverbs	10.02	17.05	17.52
Adjectives	19.00	10,31	9.53
Prepositions	2.10	4.39	3.81
Articles	4.67	4.99	4.52
Interjections	3.85	2.37	2.90
Conjunctions	2,38	1.26	1,02
Play words	.23	2.38	1.30

TABLE 3A

STATISTICAL SIGNIFICANCE OF PERCENTAGE ON PARTS OF SPEECH

	B-C		B-D		C-D	
	t	per cent	t	per cent	t	per cent
Pronouns	2.34	5-10	2.22	5-10	2.19	5-10
Nouns	2.41	5-10	2.16	5-10	2.50	5-10
Verbs	1.20	20-30	1.10	30-40	2.32	5-10
Adverbs	4.04	1	4.03	1	2.99	2- 5
Adjectives	4.04	1	4.00	1	2.45	5-10
Prepositions	4.01	1	3.96	1- 2	4.03	1
Articles	1.10	30-40	2.34	5-10	4.00	1
Interjections	2.30	5-10	.99	30-40	.10	90-100
Conjunctions	1.27	20-30	1.55	10-20	1.03	30-40
Play words	1.14	30	1.63	10-20	2.32	5-10

These are pronouns, nouns, adverbs, adjectives and all but one of the prepositions, articles. Verbs, interjections, conjunctions and play words are relatively less stable. Only the last combination of interjections shows marked unreliability.

Analysis III - Social Usage

The greatest amount of social talking, 78.17 per cent, occurred when two children were in the experimental room with the observer.

This study indicates that children 3½ years old talk more and are more sociable in small groups. From general observation we know that there is a tendency for large groups to baffle a young child.

Parallel speech occurred when a child talked to himself when someone else was in the room. The most favorable situation for this type of speech was found to be when one child was in the experimental room with an uninterested observer. Larger groups seemed to inhibit parallel speech and to stimulate social speech. Parallel speech often occurred when a child was putting the puzzle together and talking to himself about it without expecting or getting any verbal response from other children in the room who were playing with other materials.

The figures on Table 4A show that differences obtained on Social Speech and "Parallel Speech" are highly reliable. This is true of only two of the three combinations on Monologue.

Analysis IV - Piaget's Functional Analysis

Table 5 shows that children engaged in more friendly conversation as the size of the group increased. There was less criticism and commanding when a child was alone with an observer than in any other social situation. This situation in which the adult was present was not a natural one, because as was pointed out before, the adult was an observer only and discouraged social approaches. When other children were added to the group, there was more criticism, commanding, and answering questions and commands.

It is also interesting to note that four of the categories according

TABLE 4

SOCIAL USAGE

	One Child with Experimenter 6 Situations (B)	Two Children with Experimenter 15 Situations (C)	Three Children with Experimenter 20 Situations (D)
		Percentage	
Sentences that were Monologue	0	0	0
Sentences that were Parallel Speech	39.87	21.83	33.39
Sentences that were Social Speech	60.13	78.17	66.61

TABLE 4A

STATISTICAL SIGNIFICANCE OF PERCENTAGES ON SOCIAL USAGE

	B-C		B-D		C-D	
	t	per cent	t	per cent	t	per cent
Monologue	2.45	2-5	2.30	2-5	.09	90-100
Parallel Speech	3.98	1-2	4.03	1	3.75	1-2
Social Speech	3.76	1-2	3.32	2	3.65	1-2

to Piaget's functional analysis; "friendly intercourse", questions, monologue, and dual monologue, have the highest averages regardless of the size of the group.

All the comparisons on percentages of Piaget's functional analysis are fairly reliable.

On the whole, the analysis of reliability by the method of "t" statistics, shows the results of the study to be sufficiently stable; so one would expect to get comparable results by repeating this study with other similar groups of children.

Situations When a Child Was Alone

Because every child reacted as if he were in a social situation when he was alone with the observer, it was decided to try each child in the playroom entirely alone; with the observer hidden behind an observation screen.

In this situation only one of the 6 children used verbal language. She talked continuously while she was playing using a total of 60 sentences. The range of average number of words per sentence for the three social groups, 3.99, 4.07, 4.18, dropped to 2.75 when the child was entirely alone.

TABLE 5

PIAGET'S FUNCTIONAL ANALYSIS

	Alone with Experimenter 6 Situations (B)	Two Children with Experimenter 15 Situations (C)	Three Children with Experimenter 20 Situations (D)
		Percentage	
Percent of Sentences which were: Friendly Intercourse	13.49	22.25	24.09
Criticism	.52	1.71	2.97
Command	0	7.05	7.84
Questions	27.68	16.96	16.67
Answers	0	5.30	6.10
Repetition	.52	5.37	3.47
Monologue	37.55	19.18	27.49
Dual Monologue	20.04	18.86	11.31

TABLE 5A

STATISTICAL SIGNIFICANCE OF PERCENTAGES ON PIAGET'S FUNCTIONAL ANALYSIS

	B-C		B-D		C-D	
	t	per cent	t	per cent	t	per cent
Friendly intercourse	4.00	1	4.01	1	2.23	5-10
Criticism	1.06	30-40	4.03	1	4.00	1
Command	4.03	1	3.30	2- 5	3.26	2- 5
Questions	2.33	5-10	2.33	5-10	4.03	1
Answers	4.02	1	4.03	1	1.32	20-30
Repetition	2.32	5-10	4.02	1	4.02	1
Monologue	4.00	1	4.03	1	4.10	1
Dual Monologue	2.76	2-5	1.92	10-20	3.56	1- 2

The percentage of various parts of speech which the child used in the situation when she was entirely alone is substantially the same as for children in social groupings as is shown in Table 6.

According to Piaget's analysis 86 per cent of the sentences of this child were repetition. She repeated "Bunny rabbit" many times as she played with the rabbit puzzle. In this case language was an accompaniment to play activity rather than a means of communication. Twelve per cent of the sentences were classified as monologue. Examples of this type of speech are: "It is hot in here", "I don't need this", and "This is going to be a big building".

There was no criticism or commanding when the child was alone, a fact to be expected since criticism and commands are usually directed towards other people and are functions of the social group.

TABLE 6

PERCENTAGE OF PARTS OF SPEECH IN THE SITUATION WHEN THE CHILD WAS ENTIRELY ALONE

	Percentage
Pronouns	3.20
Nouns	32.09
Total of Nouns and Pronouns	35.29
Verbs	20.85
Adverbs	5.34
Adjectives	31.55
Prepositions	1.60
Articles	1.60
Interjections	0
Conjunctions	1.06
Play Words	2.62

SUMMARY AND CONCLUSIONS

An attempt has been made in this experiment to investigate the changes in various phases of the preschool child's language, when the size of the group is increased. Six children of the Purdue Nursery School, whose chronological ages ranged from 3 years, 5 months to 3 years, 10 months, served as subjects.

The children were invited into a controlled play situation, in different sized groups, and records were made of the language that occurred during ten minute periods. The data were analyzed under four classifications: type of sentence, parts of speech, social usage, and Piaget's functional analysis. The differences indicated are for the most part statistically significant.

Analysis of the data regarding type of sentence leads to the following conclusions:

1. Most talking occurs when two children are in the play situation with the experimenter.

2. The average number of words per sentence remains practically constant for the three social situations and agrees substantially with other investigations. For the 3½ year-old child it is about 4.06.

3. Only one of the 6 children talked when alone in the play situation. Speech was largely repetition, an accompaniment to activity rather than a means of communication.

When data were analyzed according to parts of speech, it was found that:

1. Nouns and noun substitutes are most used.
2. Verbs are second in frequency.
3. Adjectives and adverbs are third in frequency.
4. Other parts of speech form a minor part of the child's vocabulary and remain relatively constant as the size of the group changes.
5. Children describe action more than things as the size of the group increases.

The following trends are revealed from the analysis of social usages:

1. When the child is alone, the total speech is monologue with no social or parallel speech.
2. Social speech occurs most often when two children and an adult are in the room together.
3. The most favorable situation for parallel speech occurs when one child and an observer are in the experimental room.

When the data are analyzed according to Piaget's classification, several definite trends are noticed:

1. As the group becomes larger the language used by the children becomes more sociable and less egocentric.
2. There is slightly more criticism as the size of the group increases.
3. There are no commands when children are alone or with an adult, and the number of commands is relatively constant when other children are added to the group.
4. There are no answers to questions or commands when children are alone or with an adult; answers and questions are more frequent for groups and are relatively constant when other children are added to the group.
5. There are more questions when one child is with an adult than in any other social situation studied.
6. The amount of repetition is high in the single child situation but decreases when other children are added to the group.
7. There is a considerable amount of monologue and dual monologue even when several children are in a group together.

Of the social groups investigated, this study points out that the combination of two children and an adult results in more talking, more words per sentence, and more "friendly intercourse" than any other size of group which was included in this study. Whether this would be true of other ages or larger groups, is a question for further investigation. Because social growth is of prime importance in the life of the child, every opportunity for such experiences should be provided. From the findings of this study, we see that small social groups are the most favorable for verbal language of 3½ year-old children.

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A COMPARISON OF NEGRO AND WHITE PRESCHOOL CHILDREN ON A VOCABULARY TEST AND AN EYE-HAND COORDINATION TEST

JOSEPH E. MOORE[1]

Are negro children superior to white children in speed of reaction? Klineberg (1) contends that the difference favoring white subjects on most tests is due to environmental training. Recent investigators in attempting to ascertain whether the differences are due primarily to environmental influences employed young children rather than children who are older, and therefore more likely to show the results of training Thus far the data (2), (3), (4) reveal no statistically reliable difference between negro and white children when activities such as walking a line, threading a needle, stylus tapping, and placing marbles in holes one at a time have been employed.

The present investigation employs two measures: first, that of language, which was thought particularly susceptible to environmental influences and stimulation and second, an eye-hand coordination test which would probably parallel more closely differences due to growth and maturation and would not be so readily changed by environmental stimuli. It was hoped that the results of this investigation would throw a little more light on differences which may or may not be due to innate or maturational factors.

SUBJECTS

The subjects were drawn from private, public, and governmental (W. P.A.) nursery schools and kindergartens of Tennessee and Kentucky. The 78 negro subjects came from four different schools. The 82 white subjects came from five schools. The background and economic condition of the members of the two different groups ranged all the way from the very poor to the well-to-do.

PROCEDURE

Two individual tests were administered to each negro and to each white child used in the study. These tests were the Van Alstyne Picture Vocabulary Test for Preschool Children and the Preschool Form of the Moore Eye-Hand Coördination Test. The Van Alstyne test consists of 45 cards on each of which are four pictures of objects or experiences common to small children. A child is asked to "show" the experimenter a certain object on each card. No vocalizing is necessary, the child is merely asked to "point to" or "show" the desired object. The score is the number of cards on which the test object is correctly identified. The Moore Eye-Hand Coordination test requires a child to place 16 marbles, one at a time, in separate holes in a board. The marbles are five-eighth of an inch in diameter. The child's score is the total number of seconds necessary to repeat the test three times. A short rest period is permitted between each of the three trials. Care was taken to see that each child was seated in such a way that his arms were not forced into an awkward position, either too high or too low, as he took the test. The observations made during the practice trial afforded a means of adjusting table height or chair size to the subject. The experimenters took pains to motivate each child after each trial, no matter what the performance was, by saying, "That was good," or "You did that well."

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[1] *From Jesup Psychological Laboratory, Peabody College, Nashville, Tennessee.*

The majority of the tests were administered by the investigator, others were given by a graduate student in psychology with experience in dealing with preschool children. Each child was taken individually to a quiet room and tested. The eye-hand coordination test was given first to each child because of the ease of motivating the subject. The vocabulary test was given the following day. All testing was done in the morning hours between eight and eleven o'clock. The room in which the testing was done was quiet and enabled the child to be tested under the most favorable conditions. The children in both groups appeared to respond unusually well to both tests.

RESULTS

The results from the Van Alstyne Vocabulary Test indicate that the white children were superior to the negro children at all age levels compared, with the exception of the 42-47 month group whose median score excelled that of the white group by one word. Figure 1 gives a comparison of the number of pictures identified correctly by children in the two racial groups at different age levels.

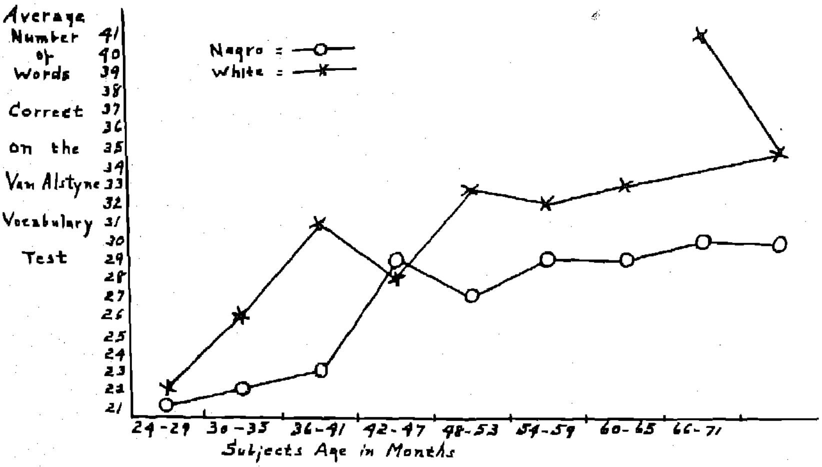

Figure 1

The data represented in Figure 1 indicate that vocabulary knowledge, as represented on the Van Alstyne Test, increases with age for both the negro and white group. The increase appears to be slower for the negro group and the curve of growth appears to flatten out a little more rapidly at the upper age groups, those from 54 to 72 months. It may be that white children have an earlier advantage of picture books, blocks, and perhaps more attention from their parents which might stimulate a superior vocabulary development. The plateau effect seen in the curve for negro children may be due to the fact that the choice of experiences used by Van Alstyne parallels those of white children more closely than would be the case for the Negroes. The two groups start only one word apart in the 24-29 month group. If the data were smoothed they would show a rather consistent trend for the white children to excel the negro children in vocabulary development in this investigation. The superiority of the white children over the negro children on the eye-hand coordination test is neither consistent nor marked at any level. Negro children were superior to white children between the ages of 24 to 35 months of age. A detailed comparison of the achievement of both white and negro children can be seen in Figure 2.

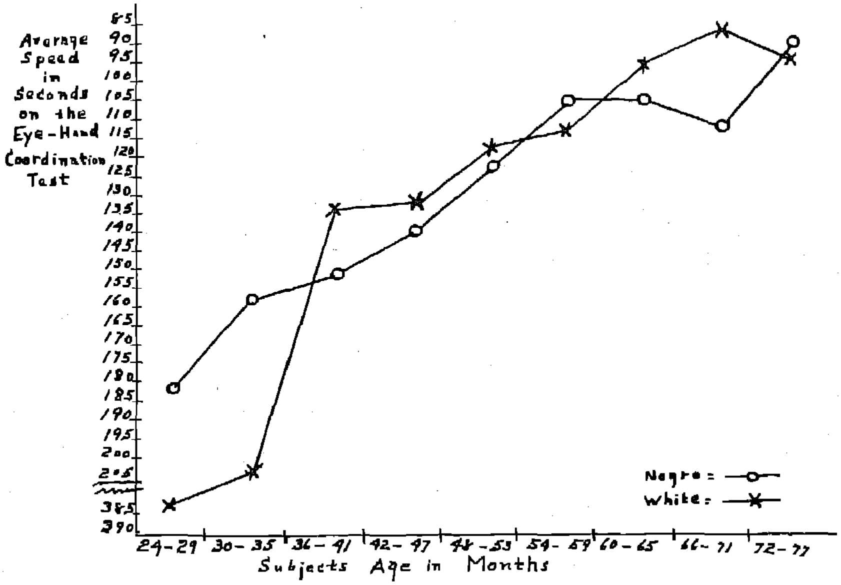

Figure 2

The similarity of the two curves representing speed of reaction for the negro and white groups stand out more than the differences. The negro children in the two youngest age groups, 24 to 35 months, are markedly superior to the white children. This superiority at the two youngest ages may or may not be due to sampling; in either case the trend of the performance is such as to warrant further investigation.

The detailed record for each age group is presented in Table 1 for the Van Alstyne Vocabulary Test and in Table 2 for the speed scores on the Eye-Hand Coordination Test.

The fact that white children in this study are more variable on the vocabulary test than are the Negroes, can be seen by consulting the average deviations in Table 1. In six of the nine age groups compared the performance on Van Alstyne Vocabulary test is more variable for the white

TABLE 1

AVERAGE NUMBER OF WORDS CORRECTLY IDENTIFIED BY 78 NEGRO AND 82 WHITE SUBJECTS ON THE VAN ALSTYNE VOCABULARY TEST BY AGE GROUPS

Months	24-29	30-35	36-41	42-47	48-53	54-59	60-65	66-71	72-77
N	3	8	7	15	20	11	8	7	3
White Mdn.	24	24	32	25	34	35	35	41	37
Mean	22.3	26	30.6	27.9	33.1	32.3	32.8	41	35
Av.D.	2.89	9.3	3.31	7.18	5.75	6.25	4.62	1.7	3.0
Voc. N	5	6	9	11	6	17	16	4	4
Negro Mdn.	21	22	22	26	28	31	29	29	30
Mean	21.2	22.2	22.6	28.5	26.6	28.8	29.1	28.8	30
Av.D.	3.0	3.2	3.9	4.1	4.5	5.03	3.3	5.3	2.5

TABLE 2

THE AVERAGE SPEED IN SECONDS FOR 78 NEGRO AND 82 WHITE SUBJECTS ON THE MOORE EYE-HAND COORDINATION TEST

Months		24-29	30-35	36-41	42-47	48-53	54-59	60-65	66-71	72-77
White	N	3	8	7	15	20	11	8	7	3
Eye Hand Coordination	Mdn.	318	182	137	133	119	106	89	88	92
	Mean	388	206	134.6	133.8	119	114	95.1	86.4	93
	Av.D.	49.0	51.0	10.0	17.3	17.8	18.7	13.9	5.3	6.7
	N	5	6	9	11	6	17	16	4	4
Negro	Mdn.	180	150	153	132	116	98	103	98	91
	Mean	182.6	158	153	140.6	122.5	106.6	104.7	112	88.5
	Av.D.	27.3	24.9	22.3	27.0	23.1	14.4	10.4	14.0	4.5

than for the negro subjects. The size of the average deviation indicating the greater variability of the white children is worth noting for the ratio on the largest to the smallest is about five to one. On the other hand, the negro children have a very small variation, only about half that of the white or two to one when the largest variation is compared to the smallest. The greater variability of the white group may tend to support the idea of a richer, more varied type of background for this group.

The results on the Eye-Hand Coordination Test shown in Table 2 indicate that white children are more variable than negro children on five of the nine comparisons. The range of the average deviations for white children is from 5 to 50 seconds, whereas that for the Negroes is only 5 to 27 seconds.

SUMMARY

1. The white children used in this study are superior to the negro children in identifying pictures on the Van Alstyne Preschool Vocabulary Test in eight out of the nine age groups compared. The growth curves for word knowledge were very similar in shape and trend. The vocabulary curve for negro children appeared to flatten out markedly at the upper age groups.
2. The results on the Preschool Form of the Moore Eye-Hand Coordination Test showed the white group superior on five out of the nine age groups. The superiority of the white group was not as marked on the eye-hand coordination as on vocabulary knowledge. The similarity of the speed curves for both negro and white children was more marked than the difference.
3. The negro subjects were less variable on both tests. On six out of the nine comparisons on the vocabulary test and five out of nine comparisons on the Eye-Hand Coordination Test the negro children appeared more homogeneous in their performance than did the white children.
4. The marked superiority of the negro children over the white children at the two youngest age groups needs further investigation to determine if the difference is due to sampling or to other factors not yet investigated, or not touched in this investigation.
5. The data in this study appear to favor the position that tests were employed which reflect cultural advantages, such as may be the case with the Van Alstyne Test, and which show a greater difference in favor of the white children than would be the case with tests less influenced by specific environmental stimulation, such as the Eye-Hand Coordination Test.

Comments

The writer regrets that a more accurate check on environmental factors such as the possession of balls, blocks, books, toys, and especially marbles was not made. It would be desirable for a more comprehensive study to be made in which the experimenter would visit in the children's homes and check with parents as to what particular blocks, toys, et cetera were and had been used by each child.

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CARDIOMETRIC STUDIES ON CHILDREN

IV. A-V NODAL ESCAPE AND NODAL RHYTHM IN AN OTHERWISE NORMAL SUBJECT[1]

WILLIAM E. POEL AND CARROLL E. PALMER

During a medical survey of more than 2400 apparently normal high school students in New York City, one pupil was found whose electrocardiogram showed A-V nodal rhythm and periods of A-V nodal escape in which the P-R interval varied from 0.04 sec. to 0.16 sec. Willingness on the part of the student to cooperate in additional experiments led to the electrocardiographic observations reported in this communication. The prevalence of nodal rhythm totaled two cases in the 2400 students examined. In addition to the case described, a 16 year-old Negro was found whose electrocardiogram showed nodal rhythm with both forward and retrograde conduction. The longest P-R interval recorded was 0.13 sec., the longest R-P interval recorded was 0.20 sec. Except for the electrocardiographic findings the boy's survey examinations showed him to be normal. Further studies could not be made at the conclusion of the survey because the boy was discharged from school and could not be located.

Physiologic Consideration of Dual Pacemakers in the Heart

"In the normal heart several centers of rhythm formation are potentially active, but the center which generates an impulse most rapidly sets the pace of the heart" (4). The pacemaker is normally the sino-auricular node, and the heart beating in response to impulses from the sinus node is said to possess "sinus rhythm". The normal sequence of the cardiac cycle exists, provided that forward conduction between the sino-auricular and auriculo-ventricular node is unimpaired and the auricular center is the more rapid. Should the rate of the A-V node become equal to that of the auricular center, sinus rhythm will be maintained only if the discharge of the sinus impulse precedes that of the A-V node by an interval at least equivalent to the normal auricle-to-ventricle conduction time for the individual. If the sinus impulse precedes that of the A-V node by an interval less than that necessary for the sinus stimulus to reach the A-V node, the auricles and ventricles will beat independently, in response to their own centers, and periods of auriculo-ventricular nodal escape will be demonstrated electrocardiographically by an inconstant P-R interval which, in an individual with unimpaired forward conduction, does not exceed his normal P-R time. However, if the rate of the A-V node should exceed that of the sinus node, or if the stimulus from the lower center should precede that from the auricle, the A-V impulse will supersede the slower auricular stimuli, and the entire heart, both auricles and ventricles, will function in response to the A-V node. The electrocardiogram under such conditions is that of auriculo-ventricular nodal rhythm.

In the case reported, the operator could cause, at will, transitions from sinus rhythm to either A-V nodal escape or nodal rhythm, and transitions from the latter two to the former through devices such as psychic stimulation, altered respiration, changes in body position, rest, or physical exertion, as well as through certain drugs, namely, atropine and epinephrine.

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[1] *From the Division of Public Health Methods, National Institute of Health, U. S. Public Health Service.*

History. The subject, a 16 year-old white girl, was first seen in New York City in December, 1939, as a participant in a medical survey of high school students. Save for a younger brother who had been a rachitic baby, the girl's family medical history was negative. Her birth had been normal, and as a child she had had good health except that she had measles at two years of age, and whooping cough at eight. Her medical history for the twelve months prior to the survey revealed only a cold that lasted five days, approximately a month before first examination. She was a senior in high school and had always done well in her studies.

Examination.[2] The girl's general appearance was normal, the body build intermediate, and her color good. An eye, ear, nose and throat examination was negative except for moderately enlarged tonsils. There was no palpable enlargement of the thyroid or lymph nodes. The blood pressure was recorded as 130/80, and the heart rate as 89. No systolic or diastolic murmurs were heard. The apical impulse was felt 7 cm. from the mid-sternal line in the fourth intercostal space.

The findings of all laboratory examinations, except the electrocardiographic and stethographic procedures, were normal. The Kline exclusion and diagnostic tests, and the Kolmer complement fixation test were all negative. There was no significant difference between the chronological age of the subject and X-ray assessment of her skeletal age. The results of urinalysis, as well as of hematological, and blood chemistry examinations were all within normal limits. The arm-to-tongue circulation time, as determined by using decholin, was 14.6 sec. The basal metabolic rate was +3 per cent. Anterior-posterior, oblique, and lateral chest plates showed no discernible cardiac or pulmonary deviations from the normal. Roentgenographic visualization of the esophagus as delineated by barium revealed no signs of growths or masses near it in the neck or chest.

The only unusual findings were those in the electrocardiogram which disclosed nodal rhythm in the standard leads, an inconstant P-R interval of 0.15 sec. or less in Lead IV_{CR} and a tendency toward right axis deviation (Figure 1).[3] A diagnosis of nodal rhythm was made on that basis, and the subject was advised that further heart tracings would be desirable.

Electrocardiographic and Stethographic Examination. Simultaneous electrocardiographic and stethographic observations were made at a number of intervals between December 1939 and August 1941. Since some of the experimental procedures were repeated at successive periods, whereas others required more than one session for completion, they are presented here according to the several techniques employed, but not necessarily in chronological sequence. Only the electrocardiograms will be considered in this report. Unless otherwise specified, the electrocardiograms reproduced here were made under normal breathing conditions.

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[2] *The authors are grateful to Acting Assistant Surgeon Frank Liberson, Acting Assistant Surgeon Isaac Apperman, and Assistant Surgeon (R) Henry I. Russek, all officers of the U. S. Marine Hospital, Stapleton, N. Y., for physical and laboratory examinations of the subject.*

[3] *Figures are placed at the end of the article.*

Production of Changes of Pacemaker

1. Psychic stimulation

   (a) The subject had never been electrocardiographed prior to the survey. The first examination and the two following checkups, in which tracings were made with the subject sitting, all yielded graphs of nodal rhythm with spontaneously occurring periods of A-V nodal escape and sinus rhythm. Subsequent tracings in the same position, by the same operator, and under the same conditions, showed normal sinus rhythm. (Compare Figure 1 with Figure 2.)

   (b) A control record taken on May 29, 1941, in surroundings familiar to the subject, shows normal sinus rhythm, with no recorded instance of nodal escape or a shortened P-R interval. (Figure 2.) A comparison tracing, taken at a Marine Hospital two days later, in the presence of a strange physician shows frequent spontaneous transitions from sinus to nodal control of the heart beat. (Figure 3-A.) A repetition of the same procedure at a later date, with the same doctor in attendance, produced graphs of regular sinus rhythm, with no variations in length of the P-R intervals. (Figure 4-A.) (Compare Figure 2.)

2. Body Position and Physical Activity

   (a) Electrodes were applied to the subject, and she rested supine for 10 minutes. A tracing at the end of the 10 minutes shows regular sinus rhythm, constant P-R intervals of 0.16 sec. duration, and a heart rate of 71. (Figure 5 A.)

   (b) The subject sat up, and a record was taken 3 minutes later. Regular sinus rhythm and the length of the P-R intervals were not affected by the change to a sitting position, but the heart rate had increased to 80. (Figure 5 B.)

   (c) The girl then arose and stood "At ease". A tracing taken 3 minutes later portrays alternating transitions of S-A and A-V nodal control of the cardiac mechanism. The heart rate had increased to 87. (Figure 5 C.)

   (d) Moderately strenuous exercise followed, in which the girl hopped on one foot until she felt tired. A record immediately after exercise shows the reestablishment of regular sinus rhythm at a heart rate of 118. The P-R intervals are again constant, but with a duration of 0.12 sec. (Figure 5 D.)[4]

   (e) Further tracings were taken at 1½, 3, and 6 minutes after exercise, while the subject sat in a chair and recovered from her exertion. The tracings 1½ minutes after exercise (Figure 5 E) indicate nodal rhythm with superposition of the P wave and QRS complex. The rate is 90. After 3 minutes of rest, the record indicates the resumption of alternate variations of S-A and A-V control of the heart beat, at a heart rate of 85. (Figure 5 F.) The tracing taken 6 minutes after exercise is practically identical with both tracings E and C above.

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[4] *Vide infra p. 265.*

3. Respiration

Tracings were taken to demonstrate the effects of, 1) normal respiration; 2) regular respiration with deeply exaggerated inspirations and exhalations; 3) interrupted respiration, in which breathing was suspended for intervals of 15 to 30 seconds immediately after a deep forced inspiration; 4) interrupted respiration, in which breathing was suspended for 10 to 20 seconds immediately after a forceful exhalation; and 5) interrupted respiration immediately after a deep inspiration, following the establishment of rapid sinus rhythm by a moderately strenuous period of exercise.

The following are apparent in the tracings obtained:

(a) Continuous normal respiration does not by itself change the pattern of heart control established by preceding physical activity. (Figure 6 A.)

(b) Interrupted respiration, with breathing stopped after a deep inspiration, invariably produces the abrupt appearance either of nodal rhythm, P-R interval variations, or a combination of the two. The sequence lasts for the duration of suspended breathing and is usually accompanied by slowing of the heart rate. (Figure 6 B.)

(c) Suspended respiration, with breathing stopped after a forced exhalation, invariably establishes sinus rhythm for as long as breathing is stopped. (Figure 6 C.)

(d) Regular respiration, with deeply exaggerated inspiration and exhalation produces cyclic variations of sinus and nodal rhythm. Sinus rhythm is seen during the expiratory portion of the breathing cycle, and A-V nodal rhythm or escape is seen to be associated with the inspiratory peaks. (Figure 6 D.)

(e) Even after exercise has established a sinus tachycardia, at a rate of from 115 to 120, a deep sustained breath precipitates the appearance of an A-V nodal rhythm or escape which persists throughout the period of arrested breathing. (Figure 6 E.) An abrupt transition to sinus rhythm is seen in the second cycle following the resumption of regular respiration. (E_2.)

4. Medication

(a) Electrocardiograms were made before and after partial atropinization was obtained with 1/150 gr. Atrop. Sul., administered hypodermically. The control tracings before atropine show a predominance of sinus rhythm, but with intermittent appearance of A-V nodal escape or rhythm. The dosage used was sufficient to establish an unvarying A-V nodal rhythm within sixteen minutes after the drug was given. There followed an unbroken period of

A-V nodal control of the heart which lasted for fifteen minutes. The first record of a P-wave was obtained again thrity-one minutes after the injection. (Figure 3 A to F.)

(b) A similar series of tracings was made at a later date to show the effect of epinephrine on the heart. Five minims (1:1000) were injected hypodermically after control tracings had been made. Subsequent electrocardiograms were taken every two to three minutes. The changes following epinephrine are not as striking as those after atropine. They do, however, indicate that the small dose employed was sufficient to upset a definite sinus rhythm and cause intermittent periods of auriculo-ventricular nodal escape. (Figure 4 A to G.)

Discussion

"The usual case of auriculo-ventricular nodal rhythm seen clinically is due to sino-auricular nodal depression from the effect of digitalis or some other cause, generally unknown" (3). In the case presented here, however, sino-auricular nodal depression is not present; the lowest heart rate recorded was 71. (Figure 5 A.) Furthermore, the P-R interval does not exceed 0.16 sec. in any instance, eliminating auriculo-ventricular dissociation due to heart block as the cause of the P-R fluctuations. A different basis for the explanation of nodal rhythm and A-V nodal escape must, therefore, be sought in this case. Since the only essential intra-cyclic fluctuations are those of the P-R interval, it seems that two active pacemakers are present; one in the sino-auricular node controlling the auricles, the other in the auriculo-ventricular node controlling the ventricles. The assumption of two pacemakers in the heart is necessitated in view of the following;

1. All P-waves and QRS complexes are within normal limits.
2. All P-waves are upright and identical in contour and duration.

   The assumption of a single pacemaker, lying somewhere in the junctional tissue or in the auriculo-ventricular node and activating both auricles and ventricles, would imply retrograde conduction to the auricles. Records of cases with retrograde stimulus conduction show distorted or inverted P-waves (1) (2). However, none of our records displays any changes whatever in the P configuration, other than those due to, and occurring at the time of, superposition of the P-wave and QRS complex.
3. All P-waves during period of A-V nodal escape are identical with the P-waves recorded in those tracings of apparent sinus control. The site of origin of all auricular impulses is therefore constant in the S-A node.
4. The QRS complexes during periods of nodal rhythm and A-V nodal escape are identical, in contour, duration, and direction, with those recorded during periods of apparent sinus control;[5] except for those changes due to, and occurring at the time of, superposition of the P and QRS configuration.

The site of all ventricular impulses is therefore constant; in the A-V node.

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[5] *Compare QRS complexes during sinus and nodal rhythm; Figs. 6 C and D.*

With the above as a basis, the P and QRS configurations may be interpreted as indicating the moments of activation of the auricles and ventricles by their respective nodes; and the variations in the P-R interval thus indicate variations in the time between the moments of such activation.

Theoretically, changes to and from nodal rhythm, A-V nodal escape and sinus rhythm may be explained as due to a depressed sino-auricular node, an auriculo-ventricular node having an enhanced rate of impulse formation, or to a combination of both the factors (1). The possibility of the case described being due to a depressed S-A node has already been ruled out. Furthermore, Figure 5 D shows that the sinus node is capable of normal physiologic response to strain and exercise. We are thus left with the only alternate possibility, a hyperactive A-V node.

The findings fit, in nearly all respects, the concept of a hyperactive auriculo-ventricular node. The cardiac variations produced by changes in body position and respiration tend to indicate that the rate of impulse formation in both nodes is almost identical, and that the vagal effects induced by body position and respiration inhibit the sinus node more than the A-V center. That concept is substantiated also by the effects of atropine and epinephrine. Figure 3 shows that release from vagal inhibition after atropine was greater for the A-V node than for the sinus node. Similarly, the action of epinephrine was to upset a dominant sinus rhythm and produce intermittent periods of A-V nodal escape. Hence the effect of sympathetic stimulation is likewise apparently greater on the A-V node than on the auricular center.

The effect of exercise on the heart was, in this subject, as interesting as it was unexpected. Since a change from a position of rest (lying down) to a more active one (standing), was accompanied by a shift in control of the heart beat from the auricular to the A-V center, it might have been expected that exercise would establish A-V rhythm even more strongly. The reverse was true, however, for Figures 5 D and 6 E show that exercise established a regular sinus rhythm at a rate of 115 to 125. The unstable nature of the sinus rhythm is nevertheless revealed by Figure 6 E, which shows that a forced deep inspiration, following exercise, overcame the activation of the S-A node, and allowed the A-V center to gain control of the heart beat at a rate of 118 for the time during which breathing was suspended.

SUMMARY

1. A medical survey of more than 2400 high school students revealed one pupil, otherwise apparently normal, whose electrocardiograms showed spontaneous transitions from normal sinus rhythm to periods of A-V nodal escape, and A-V nodal rhythm.
2. Nodal rhythm and periods of A-V nodal escape were recorded as they appeared spontaneously or were induced, at intervals over one and three-quarters years, during which periodic observations were possible.
3. In the case reported, the operator could elicit transitions in control of the heart beat between the S-A and A-V nodes through such devices as psychic stimulation, forced respiration, change in body position, rest, physical exertion, and certain drugs, such as atropine

and epinephrine.

4. The anomalous findings in the case presented are discussed in the light of hyperactivity of the A-V node.

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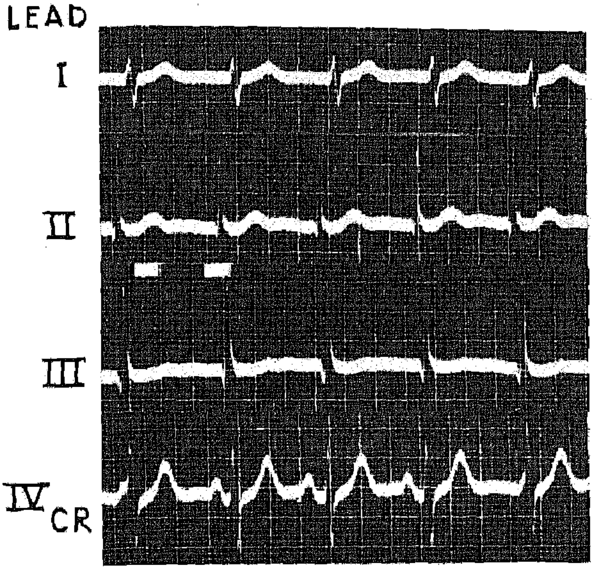

Figure 1. Routine four-lead electrocardiogram, taken in the sitting position, on December 27, 1939. Nodal rhythm is seen in the three standard leads. Lead IV$_{CR}$ shows a period of nodal escape. The tendency toward right axis deviation in the tracing is in conformity with the 'long, hanging type' of cardiac silhouette obtained by X-ray.

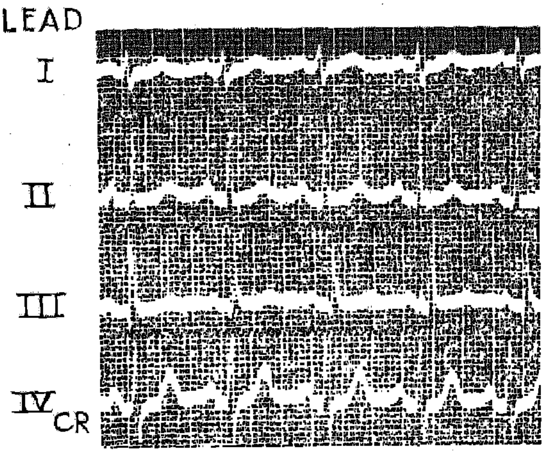

Figure 2. Subsequent electrocardiogram showing regular sinus rhythm. (Several electrocardiographic retakes in the interval between the first examination and this one had accustomed the subject to the procedure involved.)

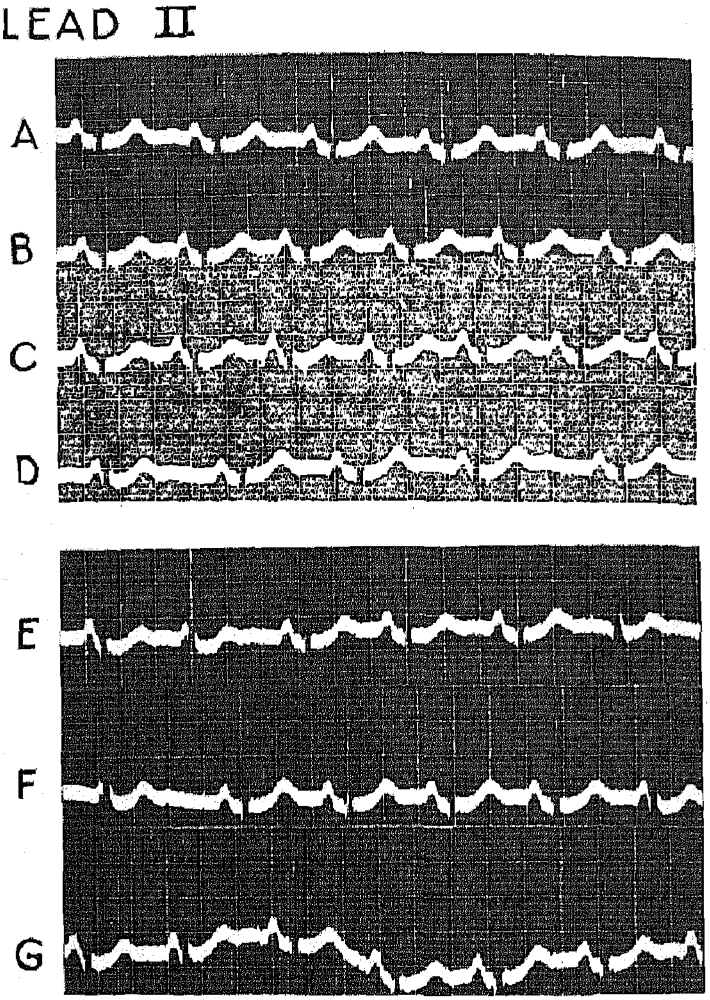

Figure 4. The effect of five minims of epinephrine administered hypodermically: All tracings are of Lead II, taken in the sitting position.

A. Before epinephrine: Regular sinus rhythm, at a rate of 90.

B. 3 mins. after epinephrine was administered hypodermically. Sinus rhythm is still present, but at a rate of 96.

C. 5 mins. after epinephrine. The second and third P-R intervals are shortened. The rate is 104.

D. 7 mins. after epinephrine. The first and fourth cycles show P-R shortening. The rate has fallen to 87.

E. 12 mins. after epinephrine. The rate is up to 106. Cycles 1, 2, and 6 show nodal escape.

F. and G. Taken 16 and 20 mins., respectively after epinephrine. Continue to show nodal escape beats.

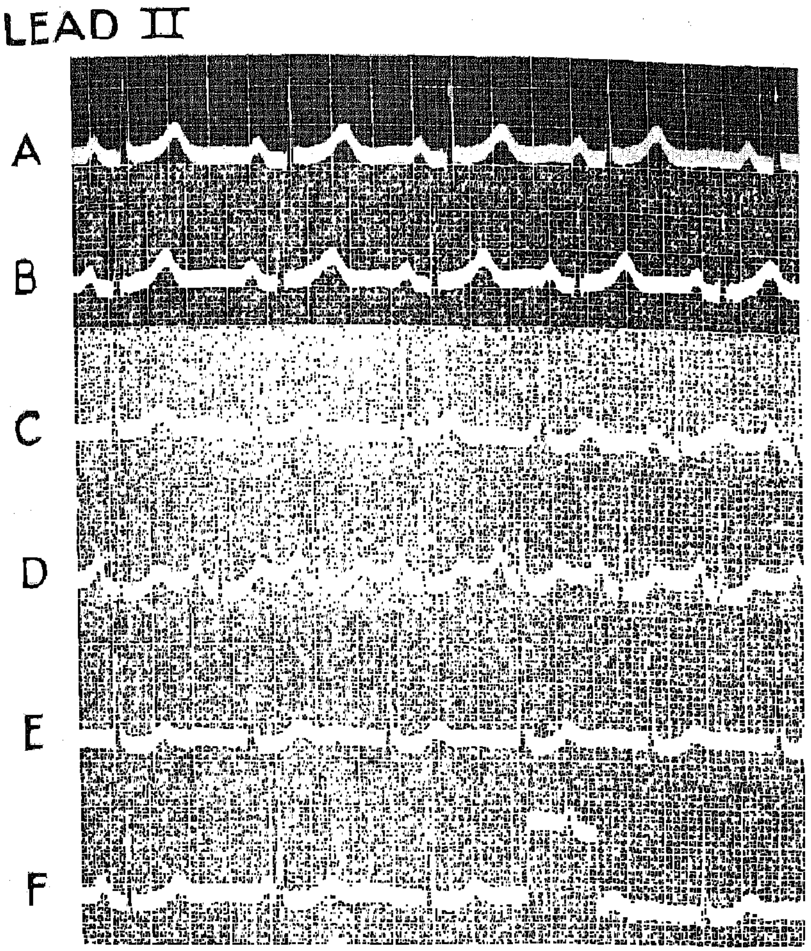

Figure 5. The effect of physical activity: All tracings are of Lead II.

A. Subject supine, after a rest period of 10 minutes: Sinus rhythm is seen; the rate is 71. P-R intervals are 0.16 sec. long.

B. Subject sitting. The rate is 80.

C. Subject standing. Regular sinus rhythm has been replaced by phasic variations from S-A to A-V rhythm.

D. Immediately after exercise: Sinus rhythm has been re-established at a rate of 118. P-R intervals are 0.12 sec. long.

E. 1.5 mins. after exercise: Nodal rhythm is present at a rate of 90.

F. 3 mins. after exercise: This tracing is essentially the same as section C above. The rate is 65.

CARDIOMETRIC STUDIES ON CHILDREN

V. VARIABLE P-R INTERVAL AND VARIATIONS OF HEART SOUNDS AND VENTRICULAR SYSTOLE[1]

WILLIAM E. POEL AND CARROLL E. PALMER

It is known that the duration of the diastolic period preceding the auricular contraction plays a large part in determining the next stroke output, and therefore the duration of ventricular systole. However, available literature does not mention the effect on the cardiac output and ventricular systole, of variations in the time interval between auricular and ventricular contractions (that is, variations of the As-Vs or P-R interval).

Wright, in his Applied Physiology (6, p. 403) says: "On the average, auricular systole is said to contribute thirty-five per cent of the total ventricular output . . . the exact proportion depending on the time in diastole at which auricular systole occurs, the vigor of auricular systole, and the completeness with which the ventricle is already filled. ... An auricular contraction early in diastole may contribute up to sixty percent of the ventricular output, whereas at the end of a long diastole, the ventricle may already be so full that the auricle can contribute relatively little."

Simultaneously recorded electrocardiograms and stethograms, obtained in a case of A-V nodal escape and nodal rhythm presented in the preceding report of this series, offered an unusual opportunity to study the effect of variations of the As-Vs or P-R interval on the duration of ventricular systole in an organically normal heart. The stethographic data and tracings herein presented also added significantly to our understanding of the relationship between variations in the time intervals of successive auricular and ventricular contractions, and the character of the changes in the heart sounds produced by those variations.

The case reported is that of a clinically normal white girl 16 years of age, in whom transition from sinus rhythm to A-V nodal rhythm or periods of A-V nodal escape occurred spontaneously or were induced in a number of ways described.

Technique. Stethographic tracings were taken routinely at the mitral, tricuspid, aortic, and pulmonic areas. A Sanborn Stetho-Cardiette was used throughout the study. The machine is arranged to record simultaneously both the sound track and the electrocardiogram on a 6 cm. bromide-paper record. Stethograms were always run simultaneously with Lead II, at a film speed of 75 mm. per sec. The length of all desired electrocardiographic and stethographic intervals was measured in half-millimeters, dropping all smaller fractions. The measurement was multiplied by 1.333 to calculate time duration in hundredths of a second.[2] The sound tracings were taken with the standard microphone and medium sized bell supplied by the manufacturers.

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[1] *From the Division of Public Health Methods, National Institute of Health, U. S. Public Health Service.*

[2] *Since the film speed is 75 mm. per sec., time can be calculated by the ratio, "Length of film (in mm.): time (in hundredths of a sec.): : 75 mm.: 1 sec."*

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The usual manner of determining the duration of systole on the stethogram is to measure the interval between the beginning of the first and second heart sounds. That method could not be used in the case presented, since the variations in the initial component of the first heart sound caused by changes in the As-Vs interval of our case make this determination of ventricular systole inaccurate. Neither could the Q-wave be used as the point from which to measure the beginning of ventricular systole because the frequent superposition of the P-wave on the QRS complex obliterates the Q-wave. Consequently systolic determinations were made by measuring the distance laterally between the peak of the R-wave in the electrocardiogram, and the beginning of the second heart sound in the stethogram. Admittedly, ventricular systole begins before the recording of the peak of the R-wave. However, the difference between the beginning of systole and the R-peak is constant for all cycles in a normal subject under normal conditions, and for our purposes is not significant.[3]

P-Q Variations and the Duration of Ventricular Systole

Changes in duration of ventricular systole, which are associated with variations of the P-Q interval, are best studied in a continuous tracing made during spontaneous cardiac transitions between sinus controlled beats, nodal beats, and cycles showing auriculo-ventricular nodal escape. A tracing of that type recorded at the mitral area, is reproduced in Figure 1.[4] Because of its length the tracing is cut into three sections, the second and third of which are continuations of the first.

The measurements of the P-Q, systolic, and diastolic intervals of all cycles in the illustration are given in columns 1 to 4 of Table 1. From those measurements it can be seen that ventricular systole is definitely lengthened when preceded by an auricular contraction. For example, the P-Q interval changes from a value of 0.00 sec. in cycle 1 to 0.133 sec. in cycle 7, and that change is accompanied by a gradual increase in ventricular systole from 0.267 sec. in cycle 1 to 0.300 sec. in cycle 7. (Columns 2 and 3 of Table 1.)

However, due to variation of physiologic factors in addition to the P-Q interval, the changes in the duration of systole are not absolutely proportional to changes in the P-Q interval. A change of 0.02 sec. in the P-Q intervals of cycles 1 and 2 produces no change in the duration of ventricular systole; whereas between cycles 9 and 10, a change of 0.007 sec. in the duration of systole occurs without any change in the P-Q interval. A correlation of columns 2 and 3 of Tables 2, 3, and 5, (as well as of Table 1) shows that the relationship between the length of the P-Q interval and the duration of ventricular systole is a direct but not a quantitatively exact one. Since there is no way to stabilize all physiologic factors affecting the cardiac mechanism, a quantitatively exact relationship can not be expected.

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[3] The Q-wave, if present, begins about 2.5 mm. before the peak of the R-wave in all cycles of Lead II. By adding that interval to the length of the 'R-to-Second-Sound' systole, and subtracting the equivalent amount from the 'Second Sound-to-R-wave' diastole, more exact values for systole and diastole are obtained.

[4] Figures are placed at end of the article.

TABLE 1

MEASUREMENTS FROM FIGURE 1; FOR CORRELATING VARIATIONS OF P-Q INTERVAL OF THE ELECTROCARDIOGRAM WITH CERTAIN CHANGES IN CHARACTERISTIC OF THE HEART SOUNDS AND VENTRICULAR SYSTOLE

(As the P-Q interval increases, ventricular systole is seen to increase, and the recorded first, second and third heart sounds undergo certain changes in outline, amplitude and duration. As the P-Q interval decreases, ventricular systole and the heart sounds undergo reverse changes.)

1	2	3	4	5	6	7
Cycle	P-Q interval (in sec.)a/	R-to-2nd sound systole (in sec.)a/	Duration of preceding diastole (in sec.)a/	Initial component of 1st heart sound	Amplitude of downward deflection; 2nd heart sound (in mm.)	Amplitude of 3rd heart sound (in mm.)
1	Absent	0.267	-	Taken as a basis for comparison	3.0	0.0+b/
2	0.020	0.267	0.273	Similar to that of cycle 1	2.5	0.0+
3	0.053	0.273	0.273	Outline differs from that of cycle 1	2.5	0.5 c/
4	0.080	0.280	0.243	Outline and amplitude differ from those of cycle 1	3.0	0.5 d/
5	0.127	0.293	0.243	Outline, amplitude, and duration vary from those of cycle 1	4.5	1.0 d/
6	0.127	0.293	0.233	Further changes in outline, amplitude, and duration are present	5.0	1.0 d/
7	0.133	0.300	0.243	Identical with that of cycle 6	4.5	0.5 c/
8	0.127	0.300	0.280	Of shorter duration than in cycle 6	5.0	0.5 d/
9	Absent	0.280	0.253	Similar to that of cycle 1	2.5	0.0 +
10	Absent	0.273	0.280	Similar to that of cycle 1	3.0	0.0 +
11	0.127	0.300	0.693	Duration, outline and amplitude exceed those of any other cycle	3.5	0.5
12	0.120	0.293	0.280	Similar to that of cycle 5	3.5	0.5 c/
13	0.043	0.287	0.247	Approximates that of cycle 1	2.0	0.5
14	Absent	-	0.267	Similar to that of cycle 1	Record ends	

a/ See text (p. 270) P-Q variations and the duration of ventricular systole

b/ 0.0 + indicates less than 0.5 mm.

c/ The third heart sound vibration coincides with the beginning of the P-wave of the following cycle (see text p. 276 "P-Q variation and the third heart sound".)

d/ The third heart sound vibration coincides with the end of the P-wave of the following cycle. (See text p. 276 "P-Q variation and the third heart sound".)

The relation between P-Q duration and systole is portrayed also in Figure 2. Both sections of the illustration are parts of a continuous tracing taken at the aortic area. In both sections, the length of the cardiac cycles is the same. However, section A shows P-Q intervals of 0.10 sec. preceding each QRS complex, while section B shows nodal rhythm with complete superposition of the P-wave and QRS configuration. The R-peaks in both sections are arranged to lie in the same vertical plane. Prolongation of systole in the section showing auricular activity can be seen by comparing the positions of the beginning of the second heart sound in the two sections. Columns 2 to 4 of Table 2 contain the measurements of the cardiac cycles recorded in Figure 2.[5]

TABLE 2

TABLE OF MEASUREMENTS FOR FIGURE 2

(The measurements from cycles A-1, A-2 and A-3 show that, barring other physiologic changes, the duration of ventricular systole and the character of the first and second heart sounds are stable if the P-Q interval is present and does not vary significantly. The measurements from cycles B-1, B-2 and B-3 show that systole and the heart sound are also constant if the P-wave (and P-Q interval) are completely absent.)

1	2	3	4	5 b/		6
Cycle	P-Q interval (in sec.)a/	R-to-2nd sound systole (in sec.)a/	Duration of preceding diastole (in sec.)a/	Initial component of 1st heart sound	2nd component of 1st heart sound	Amplitude of downward deflection; 2nd heart sound (in mm.)
A-1	0.100	0.293	-	Absent	Taken as a basis for comparison	7.5
A-2	0.100	0.293	0.253	Absent	Similar to that of cycle A-1	7.5
A-3	0.093	0.293	0.253	Absent	Similar to that of cycle A-1	7.5
B-1	Absent	0.273	-	Absent	Amplitude and contour differ from those of cycle A-1	5.0
B-2	Absent	0.273	0.266	Absent	Similar to that of cycle B-1	5.0
B-3	Absent	0.273	0.273	Absent	Similar to that of cycle B-1	5.0

a/ See, "P-Q variation and the duration of ventricular systole."
b/ The initial component of the first heart sound can not usually be recorded on a tracing from the aortic area (see text, footnote 6).

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[5] *The 'P-Q interval' and 'R-to-2nd-sound systole' columns of Table 2 show that ventricular systole is longer in cycles A-1 to A-3, where a P-Q interval is present and fairly constant, than it is in cycles B-1 to B-3, where the P-wave and P-Q interval are absent. The measurements also show that when the P-Q interval is fairly stable, as in section A, or completely absent, as in section B, the duration of ventricular systole is likewise stabilized.*

Columns 2 and 3 of Tables 3 and 4 demonstrate that the range of variation in ventricular systole due to auricular activity, lies well beyond the range due only to normal physiologic variation. The maximum difference between the longest and the shortest systolic intervals does not exceed 0.007 sec. during either sinus rhythm or nodal rhythm, for consecutive cycles of approximately the same length, provided the P-Q interval is stable or absent.

P-Q Variations and Changes in the Heart Sounds

A. P-Q Variations and the Initial Component of the First Heart Sound. The first heart sound coincides with the QRS complex, and is found directly above it on the simultaneous tracings. The exact point

TABLE 3

TABLE OF MEASUREMENTS FROM FIGURE 3

(The P-Q interval is almost completely stable in cycles 1 to 4 (cycle 4 shows a slight change of .007 sec.). The duration of ventricular systole and the first heart sound in the four cycles are constant although some change is recorded in the amplitude of the second sound. P-Q interval variations are present in cycles 5-8. The decrease in the P-Q interval is accompanied by a decrease in duration of ventricular systole and definite change in the first heart sound.)

1	2	3	4	5	6
Cycle	P-Q interval (in sec.)a/	R-to-2nd sound systole in sec.)a/	Duration of preceding diastole (in sec.)a/	Initial component of 1st heart sound	Amplitude of downward deflection; 2nd heart sound (in mm.)
1	0.133	0.326	-	Taken as a basis for comparison	1.5
2	0.133	0.326	0.306	Similar to that of cycle 1	1.0
3	0.133	0.326	0.306	Similar to that of cycle 1	1.0
4	0.140	0.326	0.332	Similar to that of cycle 1	0.5
5	0.113	0.319	0.332	Amplitude and outline differ slightly from those of cycle 1	1.0
6	0.066	0.306	0.306	Duration, outline and amplitude vary from those of preceding cycles	1.0
7	0.073	0.312	0.366	V-shaped; almost separated from body of 1st sound	0.0 + b/
8	0.073	0.312	0.352	Similar to that of cycle 7	0.0 + b/

a/ See text, "P-Q variation and ventricular systole."
b/ 0.0+ indicates less than 0.5 mm.

TABLE 4

TABLE OF MEASUREMENTS FOR FIGURE 4

	1	2	3	4	5	6
	Cycle	P-Q interval (in sec.)a/	R-to-2nd sound systole (in sec.)a/	Duration of preceding diastole (In sec.)a/	Initial component of 1st heart sound	Amplitude of downward deflection; 2nd heart sound (in mm.)
Mitral	1	0.133	0.326	-	Practically identical in the three cycles	1.0
	2	0.133	0.326	0.319		1.5
	3	0.127	0.326	0.306		1.5
Tricuspid	1	0.133	0.332	-	Practically identical in the three cycles	4.5
	2	0.133	0.326	0.293		4.5
	3	0.140	0.332	0.312		4.0
Aortic	1	0.140	0.312	-	Absent a/	3.0
	2	0.133	0.312	0.273	Absent a/	3.0
	3	0.140	0.312	0.266	Absent a/	4.0
Pulmonic	1	0.140	0.326	-	Negligible a/	2.5
	2	0.140	0.326	0.286	Negligible a/	2.5
	3	0.140	0.332	0.319	Negligible a/	2.0

a/ See text, "P-Q variation and duration of ventricular systole."

b/ The initial components of the first heart sounds, recorded on the mitral and tricuspid area tracings, end 0.5 mm. after the peak of the R-waves. The earliest vibrations of the first heart sounds recorded on the aortic and pulmonic tracings begin 0.5 mm. after the peak of the R-wave. (See also text, footnote 6.)

of coincidence depends to a great extent upon where the microphone was placed.[6] Tracings taken at the mitral area usually show a degree of clarity of detail not easily obtained at other precordial areas.

Referring therefore to the mitral area tracing of Figure 4, it is possible to distinguish four components in the record of each first heart sound. The first component consists of a short vibration of small amplitude which begins, in the four cycles shown, on the average 0.01 sec. after the initiation of the Q-wave. The first component is ended rather abruptly by the second component of the first heart sound, a thin-lined, sharply pointed, single vibration, whose amplitude is greater, and wavelength less, than that of the vibration which precedes it. The second component is quite similar in frequency and amplitude to the third which follows it, and from which it is usually separated by a definite slurring, or other irregularity of the photographed galvanometer-string deflection. Following the third component, other vibrations constituting a fourth component may be distinguished. It differs from the preceding ones by being thicker in outline and having a low indefinite frequency and a smaller amplitude of vibration.

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[6] *In Figure 4 the initial vibrations of the first heart sounds, recorded at the mitral area, begin within 0.013 sec. after the onset of the Q-deflection of the electrocardiogram; whereas in the aortic area tracing, the vibrations of the first heart sound are recorded as beginning on the average 0.044 sec. after the Q-wave. At the aortic area the delayed appearance of the vibrations is probably due to the absorption and obliteration of the weak initial deflections of the first heart sound by the tissues which conduct the sounds from their points of origin to the microphone.*

The limited variation of the different components in the first sound, when the P-Q interval is constant, is shown by the first heart sounds in Figure 3 (A), and Figure 4. (Cf. columns 2 and 5 of Tables 3 and 4.) In Figure 1, cycles 1, 2, 9, 10, and 14 may also be compared as cycles showing no auricular activity, or, as in cycle 2, only a minimal amount. (See Table 1, cf. columns 2 and 5.)

Limiting the comparison to the initial component of the first heart sound in the tracings mentioned above, it is seen that throughout any single tracing the initial components are all identical in outline and duration, and almost identical in amplitude whenever the P-Q interval is stable or absent.

A comparison of these initial components with those of the other first heart sounds recorded in Figure 1 shows that, depending on the length of the P-Q interval which precedes it, the initial component undergoes definite and characteristic changes in contour, amplitude, and duration. Some of the changes shown in Figure 1 are also listed briefly in column 5 of Table 1. The relation between the initial vibration of the first heart sound and the duration of the P-Q interval is even more clearly shown in Figure 5 (and columns 2 and 5 of Table 5). On the other hand, the lack of change in the initial component of the first heart sound is evident in Figures 3-A and 4, where the P-Q interval is seen to be quite stable.[7]

B. P-Q Variations and the Second Heart Sound. The second heart sound is identified on the tracing as the series of vibrations which lie above the terminal deflection of the electrocardiographic T-wave. Inspection of the second heart sounds recorded in the illustrations will show that they vary principally in amplitude according to the interval by which auricular systole preceded the ventricular contraction. The

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[7] *Considering the initial component of the first sound, cycle 11 of Figure 1 illustrates the fact that the length of the diastolic period preceding auricular systole is another factor which influences the character of the first heart sound. The P-Q interval of the eleventh cycle is identical with that for cycles 6 and 7. The initial component of the first sound, however, differs in all respects from those of the preceding beats. Perhaps the outstanding difference is that the initial component of the first sound in cycle 11 precedes the peak of the R-wave by 0.087 sec., while in all the other cycles, (even where the P-Q intervals are identical with that of the 11th beat) the initial vibration does not precede the R-peak by more than 0.047 sec.*

By measuring the duration of the preceding diastolic period, we find that it is more than twice as long as the diastole of any other beat in Figure 1. The resulting increased filling and distension of the cardiac chamber was probably accompanied by an increased capacity for the chamber to vibrate and transmit sound vibrations. With that assumption as a basis, the early appearance and other changes in the initial vibrations of the first sound of cycle 11 may be explained as due to a greater ventricular disturbance caused by an auricular systole occurring after a prolonged diastolic filling period; as compared with the ventricular disturbance caused by auricular systole occurring after a shorter diastolic filling time. such as is seen in other cycles in Figure 1.

TABLE 5

TABLE OF MEASUREMENTS FOR FIGURE 5*

1	2	3	4	5	6
Cycle	P-Q interval (in sec.)	R-to-2nd sound systole (in sec.)	Duration of preceding diastole (in sec.)	Initial component of 1st heart sound	Amplitude of downward deflection; 2nd heart sound (in mm.)
1	0.140	0.339	-	Taken as a basis for comparison	4.5
2	0.086	0.326	0.293	Outline differs from that of cycle 1	5.0
3	0.066	0.319	0.332	Outline and amplitude differ from those of cycle 1	3.5
4	Absent	0.306	0.319	Outline, amplitude and duration vary from those of cycle 1	3.0
5	0.126	0.326	0.585	Preceded by a base-line ripple but otherwise similar to that of cycle 1	4.0
6	0.133	0.332	0.273		5.5

* See headnote to Table 1

illustrations show that the amplitude of second sounds is greatest in cycles where the P-Q intervals are longest, and least in cycles where the P-Q intervals are smallest or absent. That observation is borne out by the tables of measurements for the illustrations which give the value for the largest downward deflection of each second sound. (Cf. columns 2 and 6 of the tables.) However, it is again evident, even more so than it was with ventricular systole, that the relationship between the P-Q interval and the second heart sound in this case is a qualitative one, and can not be expressed quantitatively as in the form of a ratio.

C. P-Q Variations and the Third Heart Sound. On a stethogram the diastolic period is demarcated as the interval between the beginning of the second heart sound and that of the first sound of the succeeding cycle (1). During diastole, a third heart sound may be detected in some individuals. When present, it usually occurs from 0.11 sec. to 0.14 sec. after the second sound (4). The third heart sound is caused by the inrush of blood to the ventricles during the period of rapid ventricular filling which takes place when the auriculo-ventricular valves open, early in diastole (6, pp. 409-410).

Since the force of impact and the turbulence created by the rush of blood into the ventricles depend largely on the pressure difference between auricles and ventricles at the moment the A-V valves open, variations of venous pressure under different conditions may cause the third heart sound to appear only intermittently in the same individual. For example, a third heart sound can be detected in the mitral area tracing of Figure 1, 0.15 sec. after the second sound, but can not be demonstrated in the mitral tracings of the other illustrations. Even in Figure 1, the intensity of the third sound vibrations is seen to vary from cycle to cycle. In the cycles where a P-wave appears simultaneously with the third heart sound, or precedes it by only a small interval, the third sound is recorded at its maximum amplitude; but in cycles where the P-wave is absent, or follows the third sound, the sound is minimal.

Figure 1, then, suggests that an auricular systole during the period of rapid ventricular filling accentuates the third heart sound, probably by augmenting the pressure difference between the auricles and the ventricles. In cycles 1, 2, 8, 9, 10, 11, and 13, P-waves either do not occur, or occur after the third heart sound, and the intensity of the sound is minimal (with few exceptions). The converse is evident in cycles 3, 4, 5, 6, 7, and 12, where the P-waves occur simultaneously with, or slightly ahead of, the third sound.

Discussion

In the case discussed in the preceding report, the presence or absence of an auricular contraction before ventricular systole, and variations in the As-Vs interval played an important part in varying the characteristics of the first, second, and third heart sound and the duration of ventricular systole. The constancy of the indicated relationships during any one day and over extended periods of time suggests that the relations reported for this instance might profitably be investigated in other such cases.

It has previously been observed that auricular activity may influence the character of the first, second, and third heart sounds. Cutts mentions variations of the first and second heart sounds detected on auscultation in many of the cases described in his report on nodal rhythm and A-V dissociation (2). Levine refers to the fact that the loudness of the first heart sound is directly related to the P-R interval (3). The possibility of an auricular systole preceding, or coinciding with a third heart sound and thereby augmenting its intensity has also been reported (5). However, the literature searched does not reveal any other investigation of the relation between the duration of ventricular systole and the time elapsing between auricular and ventricular contractions.

SUMMARY

There is presented a stethographic study of a clinically normal case, in whom spontaneous transitions between normal sinus rhythm, A-V dissociation, and nodal rhythm were detected.

In the above mentioned case, also reported in the preceding communication of this series, stethography demonstrates that:

1. Ventricular systole is invariably longer in cycles initiated by auricular activity than in comparable cycles in which there is not a complete auricular contraction preceding ventricular systole.

2. The acoustic characteristics of the first heart sound, and, to a lesser extent, of the second, vary according to the time interval between auricular and ventricular contractions.
3. The third heart sound, when present, is strengthened in intensity if it occurs simultaneously with, or slightly after, an auricular contraction.

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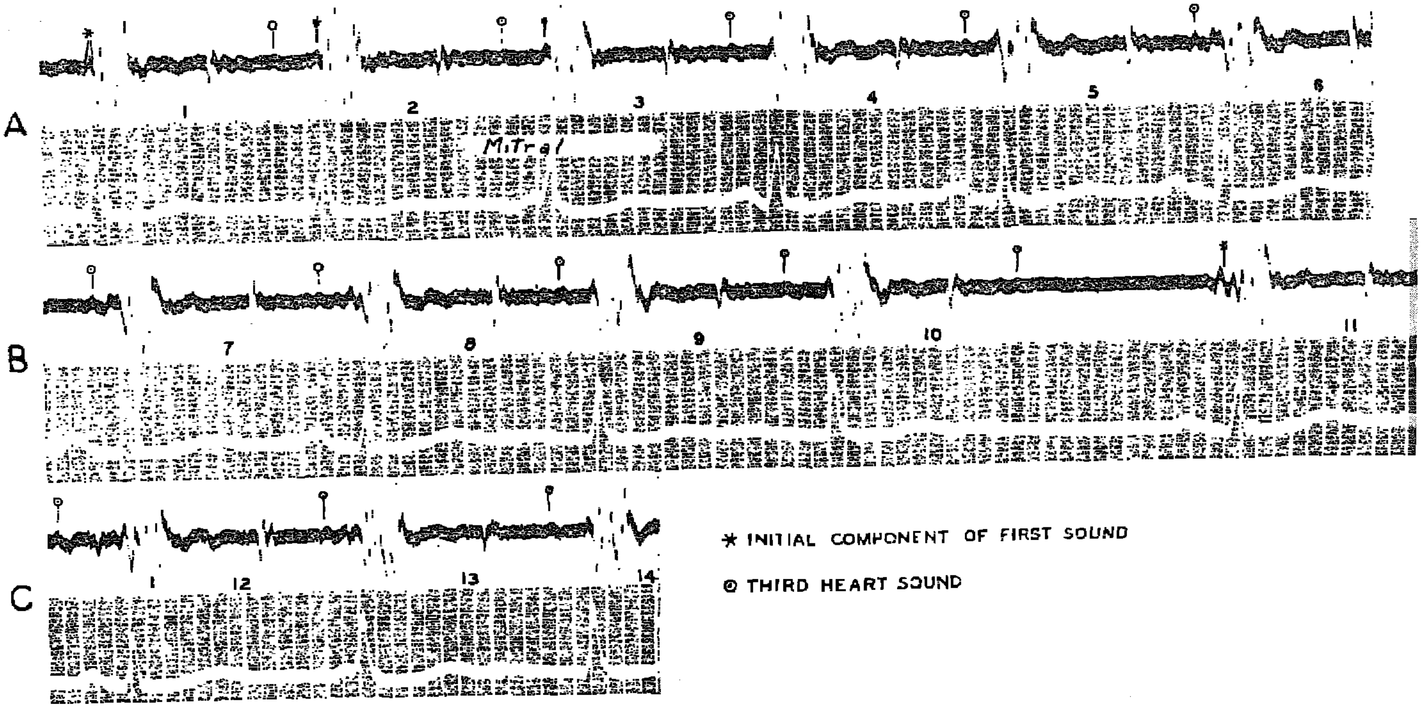

Figure 1. Mitral-area stethogram recorded simultaneously with Lead II, in sitting position. The tracing is continuous. Section A shows a transition from nodal to sinus beats; section B, an abrupt return to a sinus beat after a prolonged diastole due to nodal arrest; and section C, transition from sinus to nodal rhythm. (See text, and Table 1.)

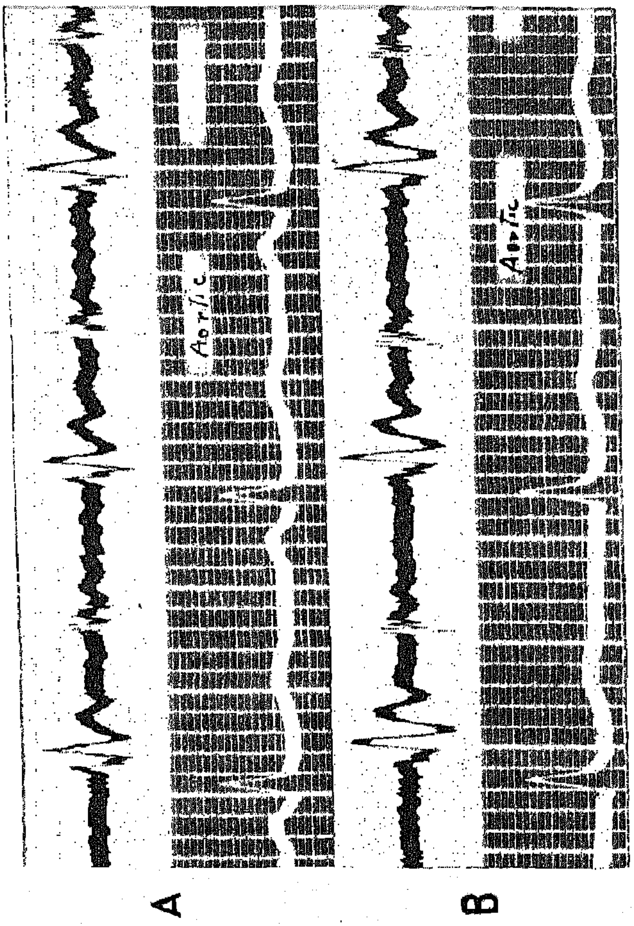

Figure 2. Portions of an aortic-area stethogram taken simultaneously with Lead II. Section A shows auricular activity preceding ventricular systole; section B shows superposition of P-and QRS-configurations. The cycle lengths in both sections are the same, and the QRS complexes lie in the same vertical planes. Note, however, that the beginning of the second heart sound in section B precedes that in section A, and the amplitude of the second sound in B is smaller than it is in A. (See text, and Table 2.)

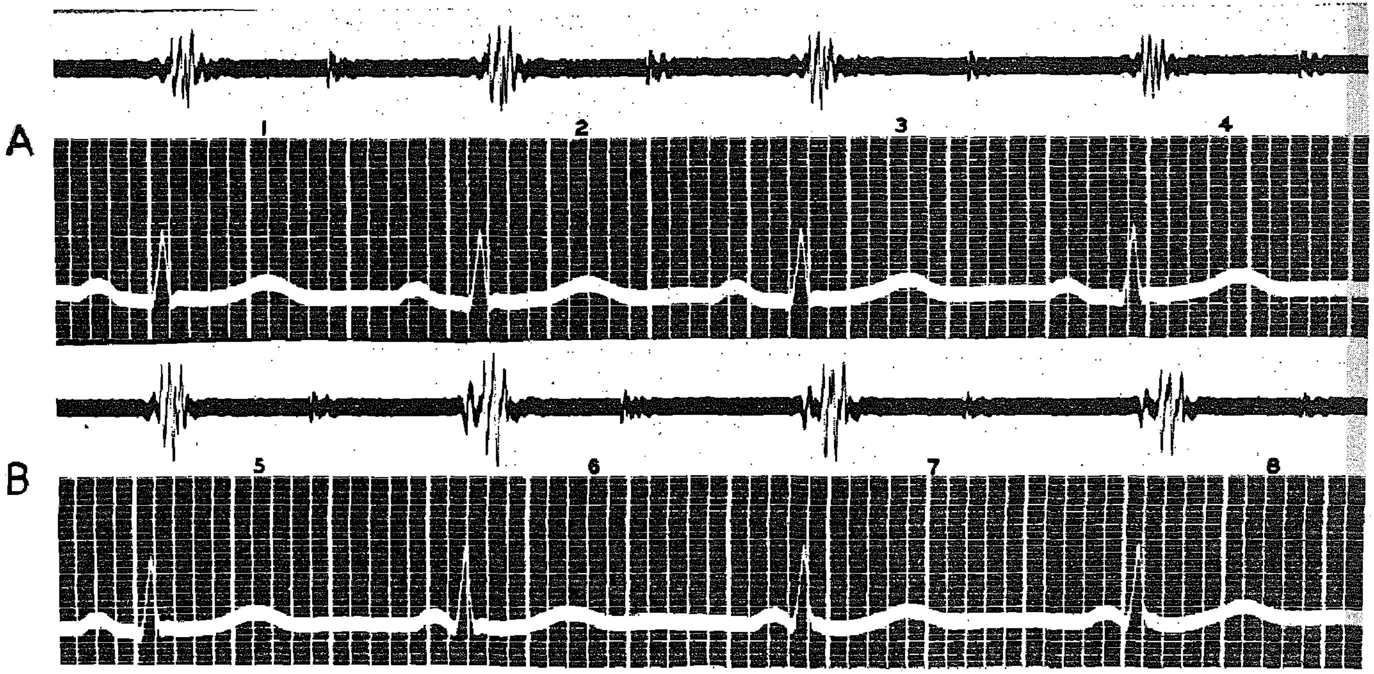

Figure 3. Mitral-area stethogram and simultaneous ECG, Lead II, taken in lying position. The tracing is continuous. A transition from sinus rhythm to A-V nodal escape begins with cycle 5. (See text, and Table 3.)

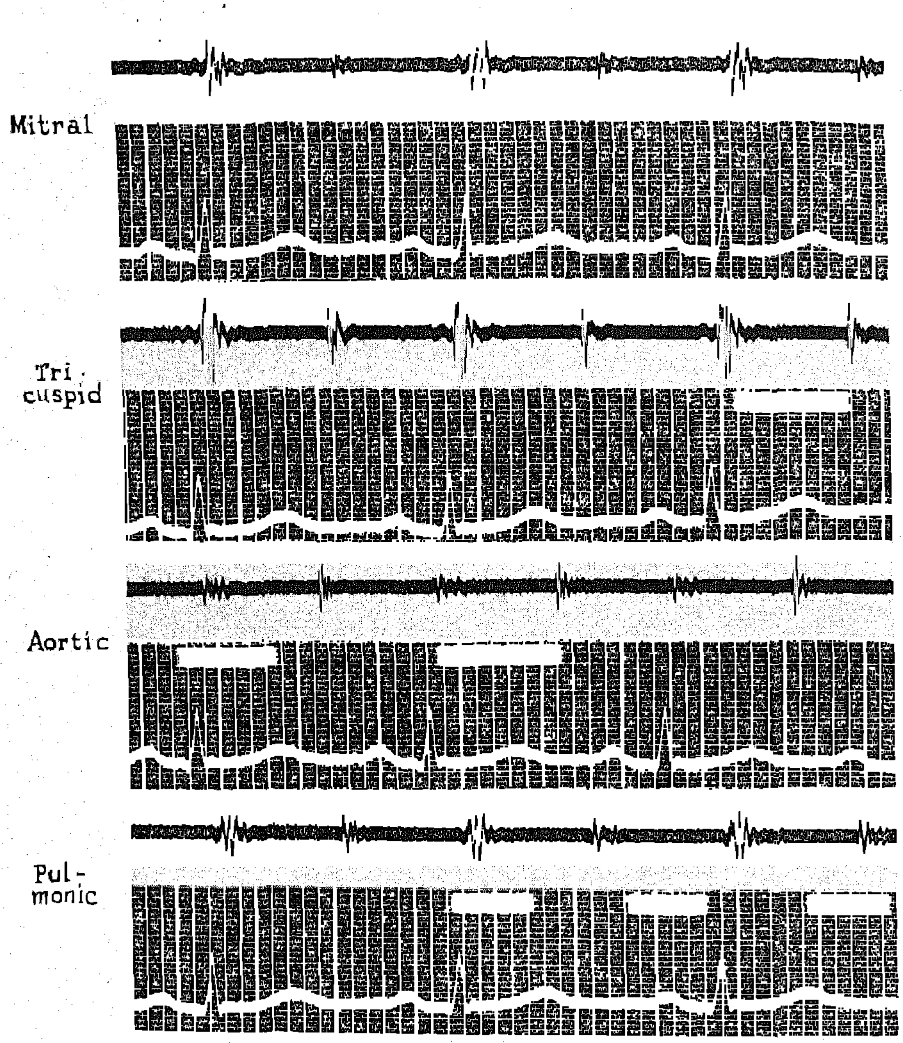

Figure 4. Stethograms taken simultaneously with Lead II, in the lying position. A. mitral-area tracing; B. tricuspid-area tracing: C. aortic-area tracing: D. pulmonic-area tracing. Sinus rhythm is present throughout. With minor exceptions, the heart sounds and duration of ventricular systole show no variation. (See text and Table 4, and compare with other illustrations.)

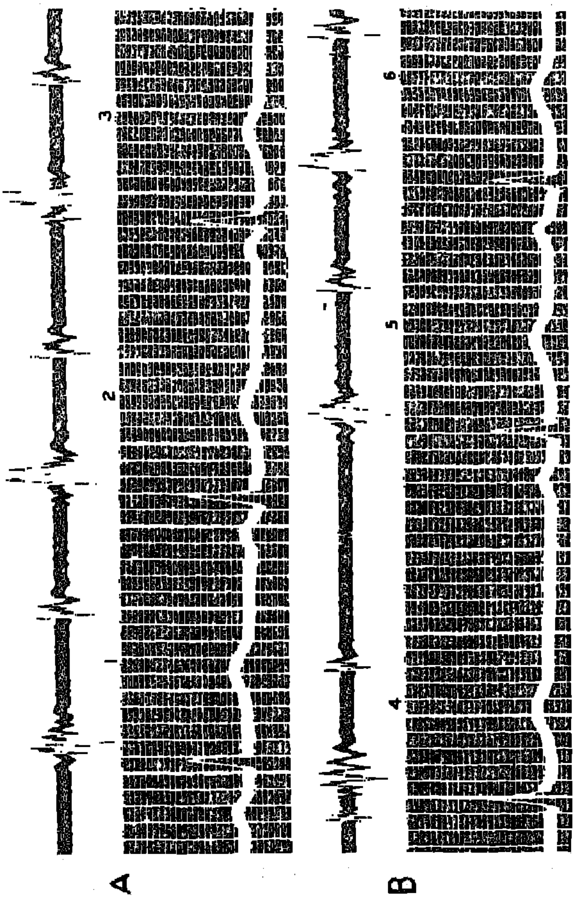

Figure 5. Tricuspid-area tracing taken simultaneously with Lead II, in the lying position. The tracing is continuous. Changes due to P-Q variations can be seen in the configuration of the first, and the amplitude of the second, heart sounds. Table 5 shows the changes in systolic length. (The vibrations preceding the first sound of cycle 4 are an artifact.)